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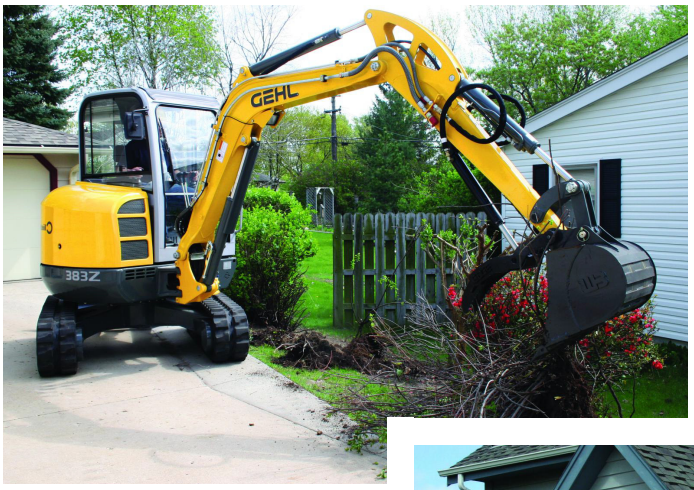
GEHL®

Form No.
918196
Revision D
Sept. 2013

383Z

Compact Excavator

Beginning Serial Number: AE00465





Operator's Manual

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GEHL COMPANY

WARRANTY

GEHL COMPANY, hereinafter referred to as Gehl, warrants new Gehl equipment to the Original Retail Purchaser to be free from defects in material and workmanship for a period of twelve (12) months from the Warranty Start Date.

GEHL WARRANTY SERVICE INCLUDES:

Genuine Gehl parts and labor costs required to repair or replace equipment at the selling dealer's business location.

GEHL MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND, EXPRESS OR IMPLIED (INCLUDING THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR PARTICULAR PURPOSE), EXCEPT AS EXPRESSLY STATED IN THIS WARRANTY STATEMENT.

ANY OF THESE LIMITATIONS EXCLUDED BY LOCAL LAW SHALL BE DEEMED DELETED FROM THIS WARRANTY; ALL OTHER TERMS WILL CONTINUE TO APPLY.

SOME STATES DO NOT PERMIT THE EXCLUSION OR LIMITATION OF THESE WARRANTIES AND YOU MAY HAVE GREATER RIGHTS UNDER YOUR STATE LAW.

GEHL WARRANTY DOES NOT INCLUDE:

1. Transportation to selling dealer's business location or, at the option of the Original Retail Purchaser, the cost of a service call.
2. Used equipment.
3. Components covered by their own non-Gehl warranties, such as tires, batteries, trade accessories and engines.
4. Normal maintenance service and expendable, high-wear items.
5. Repairs or adjustments caused by: improper use; failure to follow recommended maintenance procedures; use of unauthorized attachments; accident or other casualty.
6. Liability for incidental or consequential damages of any type, including, but not limited to lost profits or expenses of acquiring replacement equipment.

No agent, employee or representative of Gehl has any authority to bind Gehl to any warranty except as specifically set forth herein.

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TABLE OF CONTENTS

Chapter 1 - General Information 1-1
Introduction 1-1
Ownership Change 1-2
Excavator Component Identification 1-3
Specifications 1-4
Fluid Capacities/Lubricants 1-4
Engine 1-5
Hydraulic System 1-5
Undercarriage and Swing System 1-6
Dozer Blade 1-6
Electrical System 1-6
Fuse Box Under Seat 1-7
Main Fuse Box with Relays 1-7
Relays 1-8
Coolant Compound Table 1-8
Sound Levels 1-8
Vibration 1-8
General Specifications 1-9
Load Diagrams 1-10
Checklists 1-14

Chapter 2 - Safety 2-1
General Safety Information 2-1
General Safety Rules 2-1
Unauthorized Modifications 2-2
Attachment Precautions 2-2
Mandatory Safety Shutdown Procedure 2-2
Operational Safety 2-2
Exposure to Crystalline Silica 2-5
Parking the Machine 2-5
Travel Controls May Produce Reversed Travel Operations 2-5
Additional Travel Precautions 2-5
Snow, Ice and Cold Temperature Operation Precautions 2-5
Fire Hazards 2-6
Fire Extinguisher Recommendation 2-6
Additional Safety Equipment 2-6
Maintenance Safety 2-7
Safety Decals 2-8
Hydraulic Cylinder Seal Periodic Replacement 2-9
High Pressure Hydraulic Lines Store Energy 2-9
Operator's Cab and Swing Frame Deck Maintenance 2-9
Battery Electrolyte and Explosive Gas Hazard 2-9
Battery Disconnection Precaution 2-9
Jump-starting or Charging the Battery 2-9
Lifting the Machine with a Crane 2-9

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Transporting 2-10
Safety Decals 2-10
New Decal Application 2-10
ISO-Style Safety Decal Locations (Serial Numbers AG04058 and Up) 2-11
ISO-Style Information Decal Locations (Serial Numbers AG04058 and Up) 2-14
ANSI-Style Safety Decal Locations (Serial Numbers AG04057 and Before) 2-16

Chapter 3 - Operation 3-1
Operating Controls 3-1
Machine Orientation 3-1
Ignition Key Switch 3-7
Battery Disconnect Switch 3-7
Travel Controls 3-8
SAE/ISO Selector 3-9
SAE Operating Controls 3-9
ISO Operating Controls 3-9
Tilting the Cab or Canopy 3-10
Throttle Lever 3-11
Optional Auto-Idle Feature 3-11
Boom Swivel Pedal 3-12
Dozer Blade 3-12
Operator's Seat Adjustments 3-13
Seat Belt 3-14
Ventilation – Cab Only 3-14
Machine Operation 3-16
Pre-Operation Checklist 3-16
Engine Shut-down 3-17
Travel 3-18
Operating Instructions 3-21
Operating on Slopes 3-22
Operating in Cold Weather 3-23
Operating in Water 3-23
Operating Auxiliary Hydraulics 3-23
Swiveling the Boom 3-24
Excavating 3-25
Digging 3-26
Loading Vehicles 3-27
Grading 3-28
Mounting/Removing Buckets 3-28
Auxiliary Hydraulics Connections 3-30
Transporting 3-31
Lifting the Machine 3-31
Loading and Transporting 3-32

Chapter 4 - Maintenance 4-1
General Information
Care and Servicing 4-1
Care and Servicing 4-1

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Maintenance Safety 4-2
Maintenance Label Symbols 4-3
Maintenance Label 4-4
Maintenance Schedule 4-5
Check, Clean and Inspect 4-5
Fluid and Filter Changes 4-6
Air Conditioning 4-7
Functional Check 4-7
Leakage Check 4-7
Daily Lubrication 4-8
Recommended Lubricants 4-10
Engine 4-10
Changing Engine Oil and Filter 4-11
Air Cleaner 4-12
Fuel System 4-13
Cooling System 4-15
Electrical System 4-16
Battery 4-16
Hydraulic System 4-19
Checking and Adjusting V-belt Tension 4-23
Checking and Adjusting Air Conditioning V-belt Tension 4-24
Track System 4-25
Windshield Washer Fluid 4-27
Long-Term Storage 4-27
Before Storage 4-27
After Storage 4-28

Chapter 5 - Troubleshooting 5-1
Engine 5-1
Indicator Lamps 5-3
Seals and Hoses 5-3
Traveling Gear 5-4
Bucket, Boom and Dozer Blade 5-4

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NOTES

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CHAPTER 1 – GENERAL INFORMATION

INTRODUCTION

This Operator's Manual is intended to give the owner/operator assistance in preparing, adjusting, maintaining and servicing the machine. More importantly, this manual provides an operating plan for safe and proper use of the machine. Major points of safe operation are detailed in Chapter 2 – Safety.

Read and understand the contents of this manual completely and become familiar with the machine before attempting to operate it. Contact your dealer to obtain additional manuals.

Throughout this manual, information is introduced by the word **Note** or **IMPORTANT**. Be sure to read the message carefully and comply with the message. Following this information will improve operating and maintenance efficiency, help to avoid breakdown and damage and extend the service life of the machine.

Do not use the machine for any application or purpose other than described in this manual. Consult your dealer before using special attachments or equipment not approved for use with the machine. Any person making unauthorized modifications is responsible for the consequences.

The use of the machine is subject to certain hazards that cannot be eliminated by mechanical means – only by exercising intelligence, care and common sense. Such hazards include, but are not limited to: hillside operation, overloading, load stability, poor maintenance and use of the machine for purposes for which it was not intended or designed.

It is essential to have competent and careful operators, not physically or mentally impaired, who are thoroughly trained in safe operation and proper load handling.

It is recommended that operators be capable of obtaining a valid motor vehicle operator's license.

Some illustrations in this manual may show doors, guards and shields open or removed for illustrative purposes only. BE SURE all doors, guards and shields are secured in the proper operating positions BEFORE starting the engine to operate the machine.

Manitou Americas, Inc. reserves the right to make changes and improvements in the design and construction of any part without incurring the obligation to install such changes on any unit previously delivered.

The Gehl dealer network stands ready to provide any assistance you may require, including genuine Gehl service parts. All service parts should be obtained from your dealer. Give complete information about the part and include the model and serial number of the machine. Record the serial number in the following space, as a handy reference.

Purchased from:_____

Date of Purchase: _____

Model No.: _____

Serial No.: _____

Serial Number Location

The machine serial number plate (1, Figure 1-1) is located on the front frame, below the operator's cab. The cab/canopy serial number (2) is located on the right rear of the frame next to the rear window.

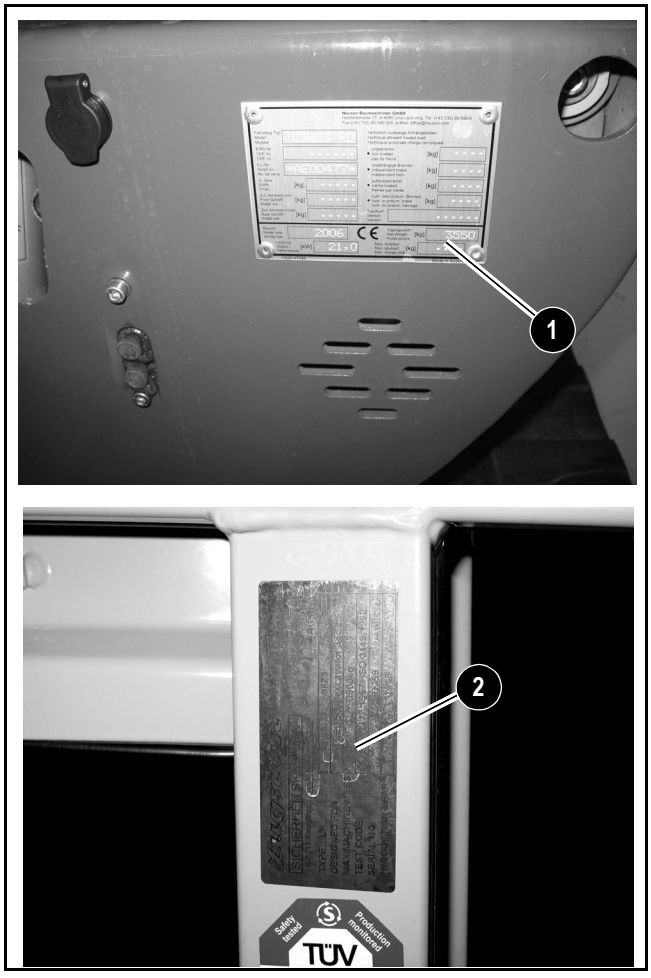


Figure 1-1 Serial Number Locations

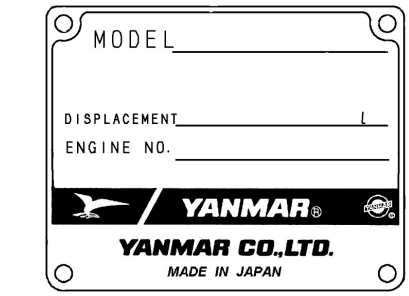
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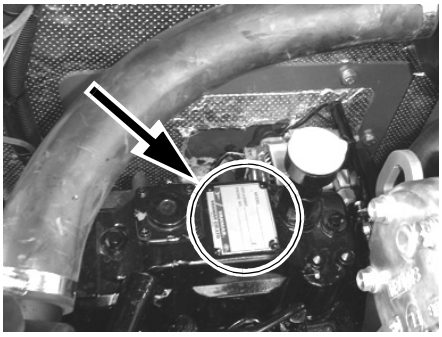
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Engine Serial Number Locations

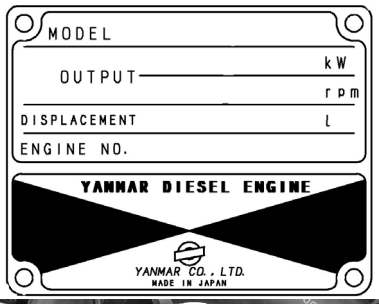
The engine serial number label is located on the cylinder head cover.

Engine serial number label
Excavators serial numbers AG00573 and up





Engine serial number label
Excavators serial numbers AG00572 and before



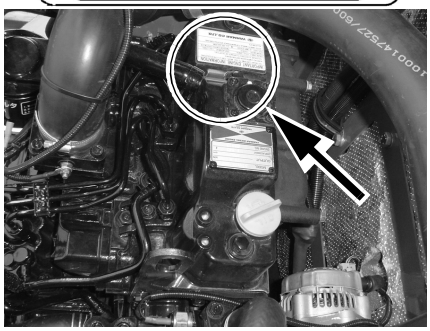


Figure 1-2 Engine Serial Number Location

Ownership Change

If this machine was purchased "used," or if the owner's address has changed, please provide your dealer or the Gehl Company Service Department with the owner's name and current address, along with the machine model and serial numbers. This will allow the registered owner information to be updated, so that the owner can be notified directly in case of an important product issue, such as a safety update program.

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EXCAVATOR COMPONENT IDENTIFICATION

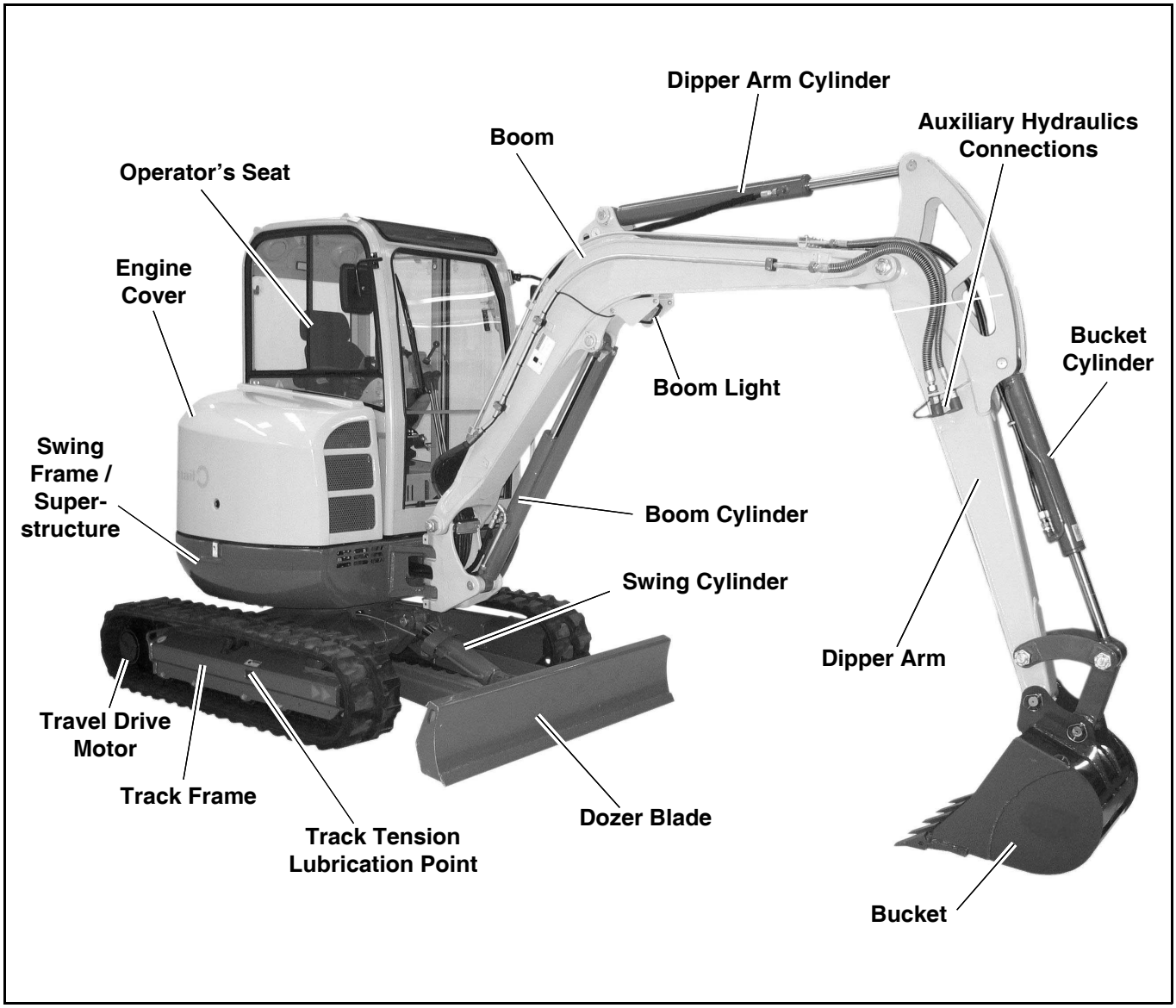


Figure 1-3 Component Names

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SPECIFICATIONS

Fluid Capacities/Lubricants

Note: *Capacities indicated are approximate.*

Component/Application	Lubricant	Specification	Season/Temperature	Capacity[a]
Diesel Engine	Engine Oil[b]	SAE 10W-40 (according to DIN 51502); API: CD, CF, CF-4, CI-4	-4°F (-20°C) +104°F (+40°C)	7.5 qts. (7.1 L)
		SAE E3, E4, E5		
Travelling Drive Gearbox Oil	Gearbox Oil[c]	Q8 T 55, SAE80W-90	Year-round	About 0.3 gal. (1.3 L) each
		FINA PONTONIC GLS SAE80W-90		
Hydraulic Oil Tank	Hydraulic Oil[d]	HVLP46 (according to DIN 51524 section 3)	Year-round	11.9 gal. (45 L)
	Biodegradable Oil[e]	PANOLIN HLP Synth 46		
		FINA BIOHYDRAN SE 46		
		BP BIOHYD SE-46		
Grease	Roller and Friction Bearings	FINA Energrease L21M	Year-round	As Required
	Open Gear (live ring gears)	BP Energrease MP-MG2		
Grease Zerks	Multipurpose Grease[f]	FINA Energrease L21M	Year-round	As Required
Battery Terminals	Acid-proof Grease[g]	FINA Marson L2	Year-round	As Required
Diesel FuelTank	Diesel Fuel	No. 2-D, DIN 51601 grade	Over 39°F (4°C)	11.6 gal. (44 L)
		No. 1-D, DIN 51601 grade	Below 39°F (4°C)	
Engine and Hydraulic Oil Cooler	Coolant	Water + antifreeze; SP-C	Year-round	1.8 gal. (5.5 L)
Air Conditioning	Refrigerating Agent	R134a	Year-round	1.7 lbs. (750 g)
	Compressor Oil	Sanden SP10		7.1 in^3 (116.5 cm^3)
Windshield Washer	Cleaning Agent	Water + Antifreeze	Year-round	5.3 gal. (2 L)

a. Capacities shown are approximate; use only oil level check to determine correct oil level
b. BP Vanellus MG 15W40, BP Vanellus C-Extra 10W30, Chevron Delo 400 15W40 or equivalent; Refer to engine operator's manual for more detailed information about recommended oil grade type use depending upon ambient temperature.
c. Hypoid gearbox oil based on basic mineral oil (API GL-4, GL-5)
d. Mobile DTE15M, Amoco Rykon 46, BP Energol HLP-HD 46 or equivalent
e. Hydraulic ester oils (HEES)
f. FINA Energrease 21M, Chevron RPM Heavy-Duty Grease No. 2, Mobilgrease Moly 52, or BP Energrease Moly EP2
g. Standard acid-proof grease

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Engine

Engine Model	Yanmar 3TNV88-PNS EPA Tier 2 Serial Numbers AE00465-AG00572	Yanmar 3TNV88-BPNS EPA Tier 3 Serial Numbers AG00573 and up
Type	Water-cooled 3-cylinder Diesel Engine	
Displacement	100.2 cu. in. (1.6 L)	
Bore and Stroke	3.5 x 3.5 in. (88 x 90 mm)	
Horsepower (DIN)	28.8 hp (21.5 kW) @ 2400 rpm	
Max. Torque	81 lb.-ft. (110 Nm) @ 1100 rpm	81 lb.-ft. (110 Nm) @ 1000 rpm
Max. Speed (with no load)	2500 +/- 25 rpm	
Idle Speed	1100 +/- 50 rpm	
Fuel Injection System	Direct Injection	
Starting Aid	Glow Plug (preheating time 10-15 seconds)	Glow Elements (preheating time 10-15 seconds)
Max. Inclined Angle (engine still supplied with oil)	25° in all directions **Note:** *This is exceeded by the machine's theoretical climbing ability (30°/ 58%)!*	
Exhaust Emission Compliance	97/68/EC Tier 2; U.S. EPA	97/68/EC Tier 3; U.S. EPA Tier 4 interim
Engine Oil Capacity	7.5 qts. (7.1 L)	
Engine Coolant Capacity	5.8 qts. (5.5 L)	

Hydraulic System

Pump	Two Variable-capacity + Two Gear Pumps
Flow Rate	2 x 10.6 gpm + 7 gpm + 3.0 gpm at 2500 rpm (2 x 40 L/min + 26.3 L/min +11.3 L/min) at 2500 rpm
Operating Pressure (working and driving)	3481 +/- 73 psi (240 +/-5 bar)
Operating Pressure (swing unit)	3045 psi (210 bar)
Operating Pressure (boom/bucket/dipper arm)	3481 +/- 44 psi (240 +/-3 bar)
Operating Pressure (dozer blade)	3045 +/- 44 psi (210 +/-3 bar)
Hydraulic Fluid Cooler	Standard
Hydraulic Reservoir (system capacity)	11.8 gal. (45 L)
Filter	Return Filter

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Undercarriage and Swing System

Travel Speed	
Low Speed	1.7 mph (2.8 km/h)
High Speed	2.9 mph (4.6 km/h)
Ground Clearance	11” (280 mm)
Swing Speed	8.8 rpm
Gradability	30° (58%)
Rubber Track Width	12” (300 mm)
Number of Track Rollers	4 per side
Average Ground Pressure	4.8 psi (0.34 kg/cm^2)

Dozer Blade

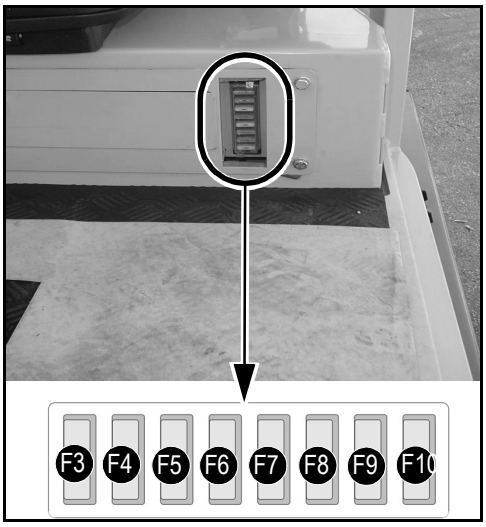
Width	68.5” (1740 mm)
Height	13.5” (345 mm)
Maximum Lift Above Ground	15” (390 mm)
Maximum Depth Below Ground	18” (450 mm)

Electrical System

Alternator	12-V, 55-A
Starter	12-V, 1.7-kW
Battery	12-V, 71-Ah, Group Size 91; 640 CCA
Socket	15-A max. - Accessory Socket (Cigarette Lighter)

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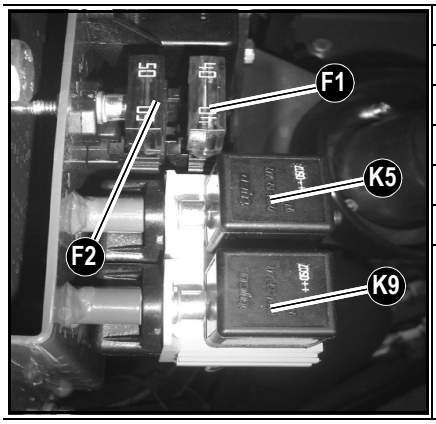
Fuse Box Under Seat



Fuse No.	Rated Current	Protected Circuit
F3	10 Amp	Indicators, Engine Relay, Cutoff Solenoid
F4	10 Amp	Boom Light
F5	15 Amp	Roof Lights
F6	10 Amp	s, Horn
F7	15 Amp	Heating, Air Conditioning
F8	10 Amp	Windshield Wiper, Interior Light
F9	10 Amp	Rotating Beacon, Radio, Drive Interlock
F10	15 Amp	Socket, Cigarette Lighter

Main Fuse Box with Relays

(located in the upper left inside the engine compartment)



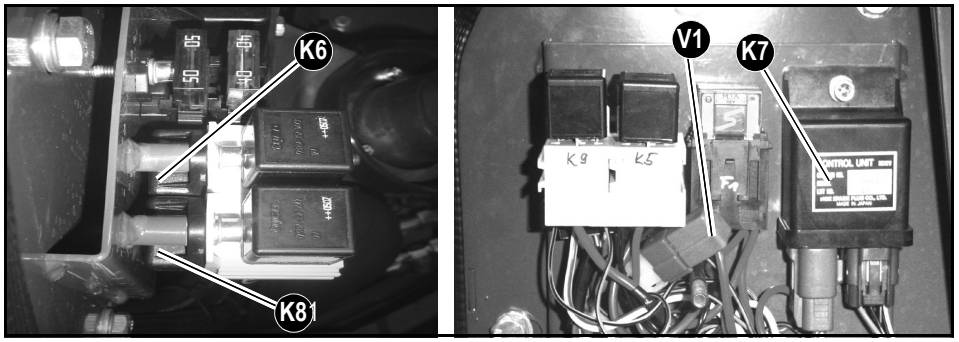
Fuse No.	Rated Current	Protected Circuit
F1	40 Amp	Start, Preheat, Cutoff Solenoid
F2	50 Amp	Main fuse, Ignition Lock

Fuse No.	Protected Circuit
K9	Cutoff Solenoid
K5	Preheating

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Relays

(located in the upper left inside the engine compartment)



Relay No.	Protected Circuit
K6	Preheating Timer
K7	Starting Relay
K8	Cutoff Solenoid
V1	Diode

Coolant Compound Table

Outside temperature	Coolant: Halvoline XLC (based on ethylene glycol)			
	Water	Anticorrosion agent		Antifreeze agent
Up to °F (°C)	% by volume	in³/gal (cm³/L)	% by volume	% by volume
39 (4)	99	2.6 (10)	1	–
14 (-10)	79			20
-4 (-20)	65			34
-13 (-25)	59			40
-22(-30)	55			44

Sound Levels

Sound Power	95 dB(A)
Sound Pressure	75 dB(A)

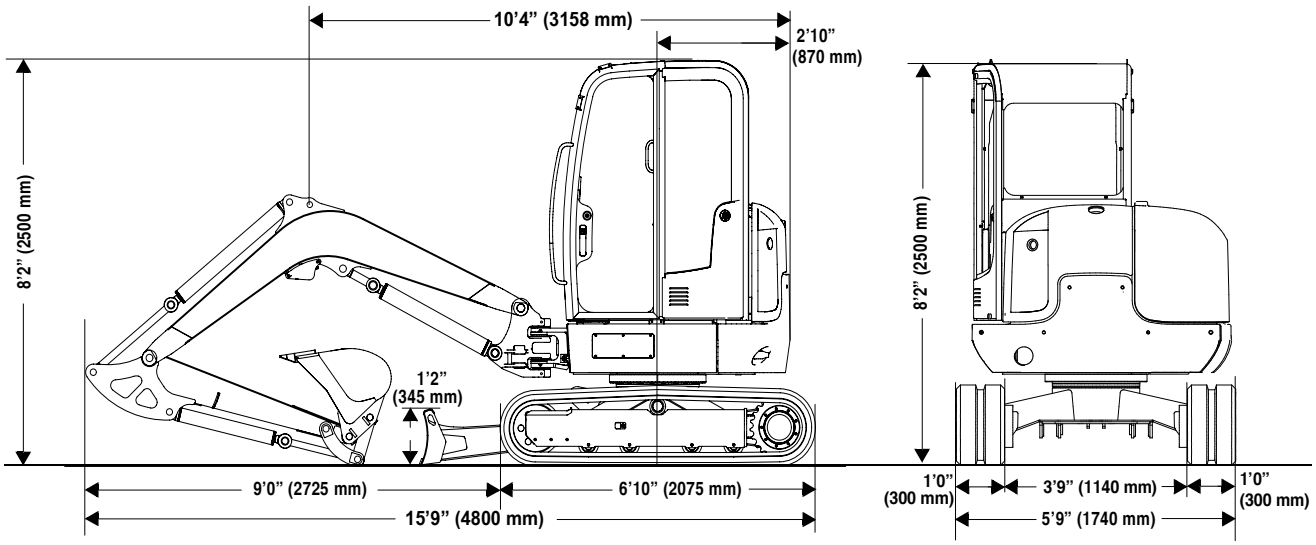
Vibration

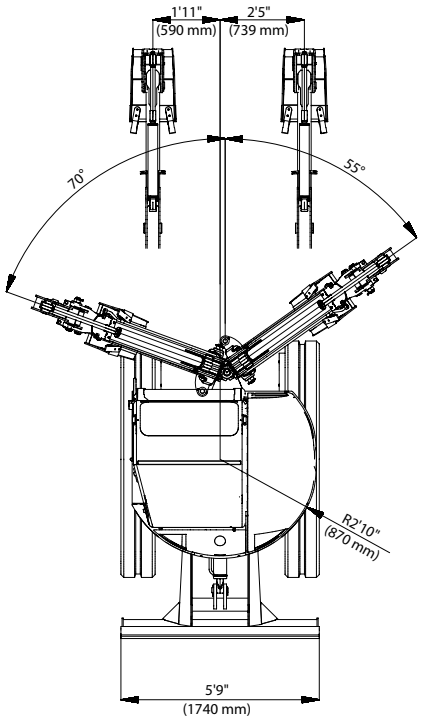
Effective acceleration value for the upper extremities of the body*	<2.5 m/s^2
Effective acceleration value for the body*	<0.5 m/s^2

*Measurements per 2002/44/EC. Machine and attachment operation and maintenance per the Operator's Manual.

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General Specifications



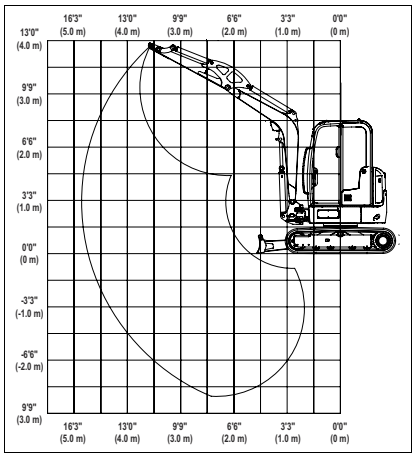


Weight (with cab)	8003 lbs. (3630 kg)
Weight (with canopy)	7826 lbs. (3550 kg)
Height	8'2" (2500 mm)
Width	5'8" (1740 mm)
Transport length	15'9" (4800 mm)
Dipper arm length (Optional Short Arm)	4'7" (1400) mm
Dipper arm length (Standard Long Arm)	5'5" (1650 mm)
Max. digging depth w/ Optional Short Arm	10'2" (3110 mm)
Max. digging depth w/ Standard Long Arm	11'0" (3360 mm)
Max. vertical digging depth w/ Optional Short Arm	8'0" (2430 mm)
Max. vertical digging depth w/ Standard Long Arm	8'9" (2670 mm)
Max. digging height w/ Optional Short Arm	14'10" (4530 mm)
Max. digging height w/ Standard Long Arm	15'3" (4660 mm)
Max. dump height w/ Optional Short Arm	10'7" (3220 mm)
Max. dump height w/ Standard Long Arm	11'0" (3350 mm)
Max. digging radius w/ Optional Short Arm	17'5" (5300 mm)
Max. digging radius w/ Standard Long Arm	18'2" (5540 mm)
Max. reach at ground level w/ Optional Short Arm	17'5" (5300 mm)
Max. reach at ground level w/ Standard Long Arm	17'10" (5430 mm)
Max. breakout force at bucket tooth	5778 lbf (25.7 kN)
Max. tearout force (Optional Short Arm)	4923 lbf (21.9 kN)
Max. tearout force (Standard Long Arm)	4383 lbf (19.5 kN)
Min. tail end swiveling radius	2'10" (870 mm)
Max. tail end lateral projection over tracks	0'0" (0 mm)
Max. boom distance to bucket center (right side)	2'5" (739 mm)
Max. boom distance to bucket center (left side)	1'11" (590 mm)
Max. boom swivel angle (left side)	70°
Max. boom swivel angle (right side)	55°

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Load Diagrams

Figure 1-4 Standard Long Dipper Arm Load Diagram



Maximum permissible loads (standard long dipper arm)

	MAX		14'9" (4.5 m)		11'6" (3.5 m)		8'2" (2.5 m)	
A / B								
9'9" (3.0 m)								
6'6" (2.0 m)			1554* (705*)	937 (425)	1477* (670*)	1422 (645)		
3'3" (1.0 m)	1664* (755*)	794 (360)	1742* (790)	904 (410)	2127* (965*)	1323 (600)	3351* (1520*)	2172 (985)
0'0" (0.0 m)	1653* (750*)	772 (350)	1863* (845*)	871 (395)	2579* (1170*)	1246 (565)	4354* (1975*)	2006 (910)
-3'3" (-1.0 m)					2590* (1175*)	1213 (550)	4233* (1920*)	1973 (895)
-6'6" (-2.0 m)							3461* (1570*)	2017 (915)

Maximum permissible load on extended dipper arm	
A	Overhang from the center of the turntable
B	Height of load fixing point
*	Lifting capacity hydraulically limited

All table values are in lbs. (kg) and for a machine in a horizontal position on firm ground without bucket.

	Dozer blade support in drive direction
	Dozer blade support 90° to drive direction

If equipped with a bucket or other implements, lift capacity or tilt load is reduced by bucket or implement weight.

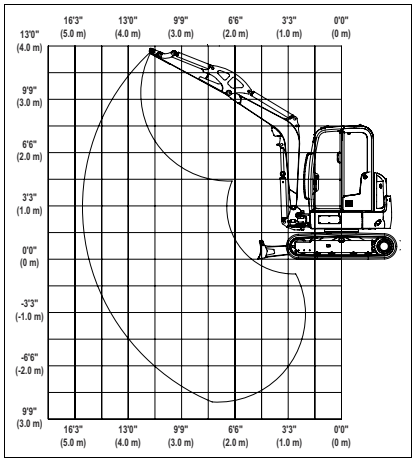
Calculation basis: According to ISO 10567.

The excavator's lift capacity is restricted by the settings of the pressure relief s and the hydraulic system's stabilizing features.

Neither 75% of the static tilt load nor 87% of the hydraulic lift capacity is exceeded.

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Figure 1-5 Standard Long Dipper Arm with Counterweight Load Diagram



Max. permissible loads (long dipper arm / counterweight)

	MAX		14'9" (4.5 m)		11'6" (3.5 m)		8'2" (2.5 m)	
A / B								
9'9" (3.0 m)								
6'6" (2.0 m)			1554* (705*)	1047 (475)	1477* (670*)	1477* (670*)		
3'3" (1.0 m)	1664* (755*)	893 (405)	1742* (790*)	1014 (460)	2127* (965*)	1477 (670)	3351* (1520*)	2414 (1095)
0'0" (0.0 m)	1653* (750*)	882 (400)	1863* (845*)	981 (445)	2579* (1170*)	1400 (635)	4354* (1975*)	2249 (1020)
-3'3" (-1.0 m)					2590* (1175*)	1367 (620)	4233* (1920*)	2216 (1005)
-6'6" (-2.0 m)							3461* (1570*)	2260 (1025)

Maximum permissible load on extended dipper arm	
A	Overhang from the center of the turntable
B	Height of load fixing point
*	Lifting capacity hydraulically limited

All table values are in lbs. (kg) and for a machine in a horizontal position on firm ground without bucket.

	Dozer blade support in drive direction
	Dozer blade support 90° to drive direction

If equipped with a bucket or other implements, lift capacity or tilt load is reduced by bucket or implement weight.

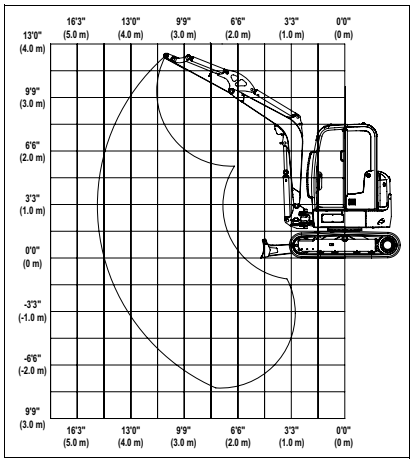
Calculation basis: According to ISO 10567.

The excavator's lift capacity is restricted by the settings of the pressure relief s and the hydraulic system's stabilizing features.

Neither 75% of the static tilt load nor 87% of the hydraulic lift capacity is exceeded.

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Figure 1-6 Optional Short Dipper Arm Load Diagram



Maximum permissible loads (short dipper arm)

	MAX		14'9" (4.5 m)		11'6" (3.5 m)		8'2" (2.5 m)	
A / B								
9'9" (3.0 m)					1455* (660*)	1455* (660*)		
6'6" (2.0 m)			1742* (790*)	937 (425)	1731* (785*)	1411 (640)		
3'3" (1.0 m)	1819* (825*)	871 (395)	1852* (840)	904 (410)	2315* (1050*)	1323 (600)	3825* (1735*)	2150 (975)
0'0" (0.0 m)	1775* (805*)	849 (385)	1885* (855*)	882 (400)	2668* (1210*)	1257 (570)	4464* (2025*)	2039 (925)
-3'3" (-1.0 m)					2557* (1160*)	1246 (565)	4134* (1875*)	2017 (915)
-6'6" (-2.0 m)							3175* (1440*)	2083 (945)

Maximum permissible load on extended dipper arm	
A	Overhang from the center of the turntable
B	Height of load fixing point
*	Lifting capacity hydraulically limited

All table values are in lbs. (kg) and for a machine in a horizontal position on firm ground without bucket.

	Dozer blade support in drive direction
	Dozer blade support 90° to drive direction

If equipped with a bucket or other implements, lift capacity or tilt load is reduced by bucket or implement weight.

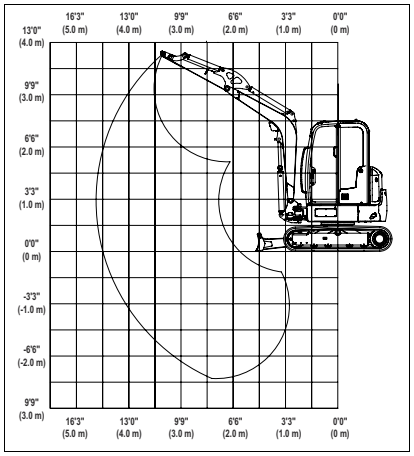
Calculation basis: According to ISO 10567.

The excavator's lift capacity is restricted by the settings of the pressure relief s and the hydraulic system's stabilizing features.

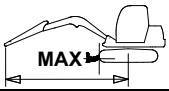
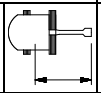
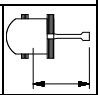
Neither 75% of the static tilt load nor 87% of the hydraulic lift capacity is exceeded.

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Figure 1-7 Optional Short Dipper Arm with Counterweight Load Diagram



Max. permissible loads (short dipper arm / counterweight)

			14'9" (4.5 m)		11'6" (3.5 m)		8'2" (2.5 m)	
A / B								
9'9" (3.0 m)					1455* (660*)	1455 (660)		
6'6" (2.0 m)			1742* (790*)	1058 (480)	1731* (785*)	1576 (715)		
3'3" (1.0 m)	1819* (825*)	992 (450)	1852* (840*)	1025 (465)	2315* (1050*)	1488 (675)	3825* (1735*)	2414 (1095)
0'0" (0.0 m)	1715* (805*)	970 (440)	1885* (855*)	1003 (455)	2668* (1210*)	1422 (645)	4464* (2025*)	2293 (1040)
-3'3" (-1.0 m)					2557* (1160*)	1411 (640)	4134* (1875*)	2282 (1035)
-6'6" (-2.0 m)							3175* (1440*)	2337 (1060)

Maximum permissible load on extended dipper arm	
A	Overhang from the center of the turntable
B	Height of load fixing point
*	Lifting capacity hydraulically limited

All table values are in lbs. (kg) and for a machine in a horizontal position on firm ground without bucket.

	Dozer blade support in drive direction
	Dozer blade support 90° to drive direction

If equipped with a bucket or other implements, lift capacity or tilt load is reduced by bucket or implement weight.

Calculation basis: According to ISO 10567.

The excavator's lift capacity is restricted by the settings of the pressure relief s and the hydraulic system's stabilizing features.

Neither 75% of the static tilt load nor 87% of the hydraulic lift capacity is exceeded.

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Pre-Delivery Checklist

The following checklist is an important reminder of valuable information and inspections that MUST be made before delivering the machine to the customer. Check off each item after the prescribed action is taken.

✓ CHECK THAT:

- ❑ Machine has not been damaged in shipment. Check for such things as dents and loose or missing parts. Correct or replace components as required.
- ❑ Battery is securely mounted and not cracked. Be sure cable connections are tight.
- ❑ Cylinders, hoses and fittings are not damaged, leaking or loosely connected.
- ❑ Coolant/radiator hoses and fittings are not damaged, leaking or loosely connected. Coolant system is filled to the proper level and has proper antifreeze protection.
- ❑ Filters are not damaged, leaking or loosely secured.
- ❑ Machine is properly lubricated and no grease fittings are missing or damaged.
- ❑ Hydraulic system reservoir, engine crankcase and drive motors are filled to their proper levels.
- ❑ All adjustments are made to comply with settings provided in *Chapter 4 – Maintenance* of this manual.
- ❑ All guards, shields and decals are in place and secured.
- ❑ Model and serial numbers for the machine are recorded in the space provided on this page and on page 1-1.

IMPORTANT

Start the engine and test run the unit while checking that all controls operate properly.

✓ CHECK THAT:

- ❑ Drive controls and boom/arm/bucket/dozer blade/swing/pivot controls operate properly and are not damaged or binding.
- ❑ Drive controls are properly adjusted for correct neutral position.
- ❑ The parking and travelling gear brake, along with the lock-out devices, are activated with the machine stationary (no pilot control pressure).
- ❑ All hydraulic functions are NOT operational with the left control console in the raised lock-out position.
- ❑ All instrument panel gauges, indicator lights, etc. function properly and all installed lights, such as work lights, function properly.

I acknowledge the pre-delivery procedures were performed on this unit as outlined on this page.

_____

Dealership's Name

_____

Dealer Representative's Name

_____

Date Checklist Filled Out

_____

Model & Serial Number

Delivery Checklist

The following checklist is an important reminder of valuable information that MUST be passed on to the customer at the time of delivery. Check off each item as you explain it to the customer.

✓ EXPLAIN:

- ❑ The *Safety* and *Operation* chapters of this manual, regarding the safe operation of the machine.
- ❑ The *Maintenance* and *Troubleshooting* chapters for information regarding the proper maintenance of the machine. Explain that regular lubrication and maintenance is required for continued safe operation and long machine life.
- ❑ Give this Operator's Manual and the AEM Compact Excavator Safety Manual to the customer and instruct the customer to read and completely understand the contents before operating the machine.
- ❑ Complete the Owner's Registration, including customer's signature and return it to Manitou Americas, Inc..
- ❑ Explain that a copy of the product warranty is included on the inside front cover of this Operator's Manual.

_____

Customer's Signature

_____

Date Delivered

RETAIN FOR CUSTOMER'S RECORDS

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Remove dealer's file copy at perforation.

Pre-Delivery Checklist

The following checklist is an important reminder of valuable information and inspections that MUST be made before delivering the machine to the customer. Check off each item after the prescribed action is taken.

✓ CHECK THAT:

- ❑ Machine has not been damaged in shipment. Check for such things as dents and loose or missing parts. Correct or replace components as required.
- ❑ Battery is securely mounted and not cracked. Be sure cable connections are tight.
- ❑ Cylinders, hoses and fittings are not damaged, leaking or loosely connected.
- ❑ Coolant/radiator hoses and fittings are not damaged, leaking or loosely connected. Coolant system is filled to the proper level and has proper antifreeze protection.
- ❑ Filters are not damaged, leaking or loosely secured.
- ❑ Machine is properly lubricated and no grease fittings are missing or damaged.
- ❑ Hydraulic system reservoir, engine crankcase and drive motors are filled to their proper levels.
- ❑ All adjustments are made to comply with settings provided in *Chapter 4 – Maintenance* of this manual.
- ❑ All guards, shields and decals are in place and secured.
- ❑ Model and serial numbers for the machine are recorded in the space provided on this page and on page 1-1.

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- ❑ Drive controls are properly adjusted for correct neutral position.
- ❑ The parking and travelling gear brake, along with the lock-out devices, are activated with the machine stationary (no pilot control pressure).
- ❑ All hydraulic functions are NOT operational with the left control console in the raised lock-out position.
- ❑ All instrument panel gauges, indicator lights, etc. function properly and all installed lights, such as work lights, function properly.

I acknowledge the pre-delivery procedures were performed on this unit as outlined on this page.

_____

Dealership's Name

_____

Dealer Representative's Name

_____

Date Checklist Filled Out

_____

Model & Serial Number

Delivery Checklist

The following checklist is an important reminder of valuable information that MUST be passed on to the customer at the time of delivery. Check off each item as you explain it to the customer.

✓ EXPLAIN:

- ❑ The *Safety* and *Operation* chapters of this manual, regarding the safe operation of the machine.
- ❑ The *Maintenance* and *Troubleshooting* chapters for information regarding the proper maintenance of the machine. Explain that regular lubrication and maintenance is required for continued safe operation and long machine life.
- ❑ Give this Operator's Manual and the AEM Compact Excavator Safety Manual to the customer and instruct the customer to read and completely understand the contents before operating the machine.
- ❑ Completely fill out the Owner's Registration, including customer's signature and return it to the Gehl Company.
- ❑ Explain that a copy of the product warranty is included on the inside front cover of this Operator's Manual.

_____

Customer's Signature

_____

Date Delivered

RETAIN FOR DEALER'S RECORDS

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(To be removed as dealer's file copy)

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CHAPTER 2 – SAFETY

GENERAL SAFETY INFORMATION

Manitou Americas, Inc, in cooperation with the Society of Automotive Engineers (SAE), has adopted this safety alert symbol: ⚠ This warning symbol, used with a "signal word," indicates situations or conditions that can cause injury or death if precautions are not followed. The signal words used with the safety alert symbol are:

"**CAUTION**," "**WARNING**," and "**DANGER**," which indicate the level of risk and severity of hazards. All three levels indicate that safety is involved. Observe the precautions whenever you see the safety alert symbol, no matter which signal word is used.

The following signal words are used throughout this manual and on decals on the machine to warn of potential hazards:

⚠ DANGER

"DANGER" indicates an imminently hazardous situation, which, if not avoided, will result in death or serious injury.

⚠ WARNING

"WARNING" indicates a potentially hazardous situation, which, if not avoided, could result in death or serious injury.

⚠ CAUTION

"CAUTION" indicates a potentially hazardous situation, which, if not avoided, may result in minor or moderate injury. May also alert against unsafe practices.

IMPORTANT

"IMPORTANT" is used to draw attention to a procedure that must to be followed to prevent machine damage.

GENERAL SAFETY RULES

Before operating the machine, first read and study the safety information in this manual. Be sure that anyone who operates or works on the machine is familiar with the safety precautions. This includes providing translations of the warnings and instructions for operators who are not fluent in reading English.

It is essential that operators be thoroughly trained in the safe operation of the machine and handling loads. Operators must not be physically or mentally impaired. Do not allow minors or unqualified personnel to operate the machine, or to be near the machine unless they are properly supervised. It is recommended that the operator be capable of obtaining a valid motor vehicle operator's license.

Only trained and authorized personnel, with a full awareness of safe procedures, should be allowed to operate or perform maintenance or service on the excavator.

Read the operator's manual provided with each attachment before using it.

Use of the machine is subject to certain hazards that cannot be eliminated by mechanical means, but only by exercising intelligence, care and common sense. Such hazards include: hillside operation, overloading, load instability, poor maintenance, and using the machine for a purpose for which it was not intended or designed.

Manitou Americas, Inc. always takes operator's safety into consideration during the design process. Guards and shields are provided, which protect the operator and bystanders from moving parts and other hazards. Operators must be alert, however, because some areas cannot be guarded or shielded without preventing or interfering with proper operation.

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Different applications may require optional safety equipment. Users must evaluate the worksite hazards and equip the machine and the operator as necessary. The information in this manual does not replace any applicable safety rules and laws. Before operating the machine, learn the rules and laws for the local area. Make sure the machine is equipped as required according to these rules/laws.

Remember that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause permanent injuries.

Some photographs in this manual may show doors, guards and shields open or removed for the purposes of illustration only. Be sure all doors, guards, shields and panels are in the proper operating positions before starting the engine to operate the machine.

Do not modify the Falling Object Protective Structure ("FOPS") unless instructed to do so in approved installation instructions. Modifications, such as welding, drilling or cutting, can weaken the structure and reduce the protection it provides. A damaged protective structure cannot be repaired – it must be replaced.

For safety reasons, use only genuine replacment service parts. For example, using incorrect fasteners could lead to a condition in which the safety of critical assemblies is dangerously compromised.

The machine is designed and intended to be used only with approved attachments. To avoid possible personal injury, equipment damage or performance problems, use only attachments that are approved for use on and within the rated operating capacity of the machine. Contact your dealer or the Manitou Americas, Inc. service department for information about attachment approval and compatibility with specific machine models. Manitou Americas, Inc. cannot be responsible if the machine is used with non-approved attachments.

Do not use the machine for any application or purpose other than described in this manual.

Unauthorized Modifications

Any machine modification made without authorization from Manitou Americas, Inc. could create a safety hazard, for which the machine owner would be responsible.

For safety reasons, use only genuine replacement service parts. For example, using incorrect fasteners could lead to a condition in which the safety of critical assemblies is dangerously compromised.

Attachment Precautions

Optional kits are available through your dealer. Contact your dealer or the Manitou Americas, Inc. service department for information on available one-way (single-acting) and two-way (double-acting) piping/valving/auxiliary control kits. Because Manitou Americas, Inc. cannot anticipate, identify and test all of the attachments that owners may want to install on their machines, please contact Manitou Americas, Inc. for information on approval of attachments, and their compatibility with optional kits.

MANDATORY SAFETY SHUTDOWN PROCEDURE

Before leaving the machine:

1. Bring the machine to a complete stop on a level surface. Avoid parking on an incline or a hillside, but if this is not possible, park across the slope; place chocks under the tracks to prevent the machine from moving.
2. Lower the working equipment to the ground and support it securely.
3. Run the engine at idle speed for a few minutes to allow systems to cool after operation at full speed.
4. Turn the key fully counter-clockwise to shut off the engine. Wait for all movement to stop.
5. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
6. Lock out controls by raising left control console.
7. Remove the ignition key and take it with you. Exit the machine using the hand-holds.

OPERATIONAL SAFETY

Before Operation

Contact the proper local authorities for utility line locations BEFORE starting to dig. In North America, contact the North American One-Call Referral System at 8-1-1 in the U.S., or 1-888-258-0808 in the U.S. and Canada.

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Remove all trash and debris from the machine every day, especially in the engine compartment, to minimize the risk of fire.

The operator's area, steps and hand holds must be kept free of oil, dirt, ice and unsecured objects.

Never use ether starting aids. Glow plugs are used for cold weather starting. Glow plugs can cause ether or other starting fluid to detonate, causing injury or damage.

Walk around the machine and inspect it before using it. Look for damage, loose or missing parts, leaks, etc. Repair as required before using the machine.

Check the tracks for damage at regular intervals. Repair or replace as necessary.

Warn all nearby personnel before starting the machine.

Below-ground hazards also include water mains, tunnels and buried foundations. Know what is underneath the work site before starting to dig.

Before working near power lines (either above-ground or buried cable-type), always contact the power utility and establish a safety plan with them.

Be aware of height obstacles. Any object in the vicinity of the boom could represent a potential hazard, or cause the operator to react suddenly and cause an accident. Use a spotter or signal person when working near bridges, phone lines, work site scaffolds, or other obstructions.

Depending upon the voltage in the line and atmospheric conditions, strong current shocks can occur if the boom or bucket is closer than 10 ft. (3 m) to the power line. Very high voltage and rainy weather can further increase the safe operating distance.

If a lighting system is installed, check its operation before working in darkness.

Use warning tag/control lockout procedures during service. Alert others that service or maintenance is being performed by tagging the operator's controls — and other machine areas if required — with a warning notice. **NEVER** start the engine if there is any indication that maintenance or service work is in progress, or if a warning tag is attached to controls in the cab.

Replace damaged safety decals and a lost or damaged operator's manual. Always store this operator's manual in the storage compartment provided for it inside the cab.

Work crew members should observe and monitor all terrain and soil conditions at the work site, along with traffic, weather-related hazards and any above- or below-ground obstacles and hazards.

If the machine is equipped with a cab, keep the windshield, mirrors and windows clean. If equipped, adjust the rearview mirrors to provide the best view to the rear of the machine. Poor visibility can cause accidents.

Adjust the seat to allow complete and comfortable access to the controls. Never adjust the seat during machine operation.

Stop the engine and lock out the controls by raising left control console before mounting attachments. Check that attachments are securely fastened to the excavator before using them.

Before working on or with the machine, remove jewelry, tie back long hair, and do not wear loose fitting garments, such as, scarves, ties, unzipped jackets, etc., which could become caught in the moving parts of the machine and cause injury.

Do not use the machine when maintenance is scheduled to be performed. Postponing maintenance can result in a serious reduction of the service life of the machine, more serious and costly equipment failures, and contribute to unsafe operating conditions.

During Operation

ALWAYS fasten the seat belt securely and properly. Never operate the machine without the seat belt fastened around the operator.

Operate ONLY while seated in the operator's seat. Never reach in through a window to work a control. Do not try to operate the excavator unless you're in the operator's position, seated at the controls. Stay alert and focused on your work at all times.

Always keep hands and feet inside the operator's compartment while operating the machine.

Control the machine cautiously and gradually until fully familiar with all the controls and handling. Avoid high-voltage lines. Serious injury or death can result from contact or proximity to high-voltage electric lines. The bucket or boom does not have to make physical contact with power lines for current to be transmitted.

Use care on loose ground. Working heavy loads over loose, soft ground or uneven, broken terrain can cause dangerous side-load conditions and possible tip over and injury. Traveling with a suspended load or an unbalanced load can also be hazardous.

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Stay away from ditches and other weak support surfaces. Be sure the surrounding ground has adequate strength to support the weight of the machine and the load.

If temperatures are changing, be cautious of dark and wet patches when working or traveling over frozen ground.

Stay away from ditches, overhangs and other weak support surfaces. Halt work and install support mats or blocking if work is required in an area of poor track support.

Overhangs are hazardous. Digging under an overhang is dangerous. Know the height and reach limits of the excavator and plan ahead while working. Avoid creating dangerous situations caused by moving around the work site while making excavations. Move to another digging area before large overhangs are formed. Working around deep pits or along high-walls or trenches may require support blocks, especially after heavy rainfalls or during spring thaws. Park the excavator away from overhangs.

Exposed hydraulic hoses could react with explosive force if struck by falling or overhead items. NEVER allow hoses to be hit, bent or interfered with during operation. Extra guards may be required. Replace any damaged hoses.

To avoid tipping, travel with the bucket or attachment as low as possible: 8–12 inches (200–300 mm) from the ground. In an emergency, lower the attachment immediately to the ground to aid stopping the machine.

Sloping terrain requires caution. Dig evenly around the work site whenever possible, trying to gradually level any existing slope. If it is not possible to level the area or avoid working on a slope, reduce the size and cycling rate of the load.

On sloping surfaces, use caution when positioning the excavator prior to starting a work cycle. Stay alert for instability situations. For example, always avoid working the bucket over the downhill crawler tracks when parked perpendicular to the slope. Slow all downhill swing movements and avoid full extensions of the bucket in a downhill direction. Lifting the bucket too high, too close to the machine, while the excavator is turned uphill can also be hazardous.

If the machine becomes unstable and starts to tip, keep the seat belt fastened, hold on firmly and brace yourself. Lean away from the point of impact and stay with the machine. If tipping occurs, DO NOT jump from the machine. The machine is equipped with rollover protection, which can only protect the operator while in the operator's seat. Trying to escape from a tipping machine can result in death or serious personal injury.

Stay alert for people moving through the work area. When loading a truck you should always know where the driver is.

Avoid loading over the cab of a truck, even if the driver is in a safe spot, because someone else could have gone inside.

Slow down the work cycle and use slower travel speeds in congested or populated areas. Use commonly understood signals so that other members of the work crew can warn the operator to slow or halt work in a potentially hazardous situation.

Use a signal person if you can't see the entire work area clearly.

Use a spotter and hand signals to keep away from power lines not clearly visible to the operator.

All personnel at the work site should be aware of assigned individual responsibilities. Communication and hand signals used should be understood by everyone.

Terrain and soil conditions at the job site, approaching traffic, weather-related hazards and any above-or below-ground obstacles or hazards should be observed and monitored by all work crew members.

Be aware that attachments affect the handling and balance of the machine. Adjust the operation of the machine as necessary when using attachments.

Before coupling or uncoupling the hydraulic lines for the attachment, stop the engine and release the pressure in the hydraulic system by moving the joysticks in all directions a couple of times.

DO NOT raise or lower a loaded bucket suddenly. Abrupt movements under load can cause serious instability.

Make sure that no one comes inside the swing radius of the machine. Anyone standing near the track frames, swing frame or the attachment is at risk of being caught between moving parts of the machine.

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Do not use the machine to lift or transport people. Never carry riders. Do not allow others to ride on the machine or attachments, because they could fall or cause an accident.

Unless necessary for servicing the engine, the engine hood must not be opened while the engine is running.

Engine exhaust gases can cause unconsciousness and fatalities. Ensure adequate ventilation before starting the engine in an enclosed area.

Operators should also be aware of any open windows, doors or ductwork into which exhaust gases may be carried, exposing others to danger.

Do not overload the machine. See "Load Diagrams", starting on page 1-10, for load limits.

If the machine becomes damaged or malfunctions, stop the machine immediately and lock and tag it. Repair the damage or malfunction before using the machine.

Never jump off the machine. Always leave the machine using the steps and hand-holds. Never get on or off a moving machine.

Exposure to Crystalline Silica

Exposure to crystalline silica (found in sand, soil and rocks) has been associated with silicosis, a debilitating and often fatal lung disease. A Hazard Review (Pub. No. 2002-129) by the U.S. National Institute for Occupational Safety and Health (NIOSH) indicates that a significant risk (at least 1 in 100) of chronic silicosis for workers exposed to inhaled crystalline silica over a working lifetime. NIOSH recommends an exposure limit of 0.05 mg/m3 as a time-weighted average for up to a 10-hr workday during a 40-hr workweek. NIOSH also recommends substituting less hazardous materials when feasible, using respiratory protection, and regular medical examinations for exposed workers.

Parking the Machine

When shutting down the machine for the day, plan ahead so that the excavator will be on a firm, level surface away from traffic and away from high-walls, cliff edges and any area of potential water accumulation or runoff. If parking on an incline is unavoidable, block the crawler tracks to prevent movement. Lower the bucket and dozer blade to the ground. There should be no possibility of unintended or accidental machine movement.

After the machine has been parked properly, shut down the machine according to the "Mandatory Safety Shutdown Procedure" on page 2-2.

Travel Controls May Produce Reversed Travel Operations

Before starting the machine, always check to see which end of the track frame is under the operator's cab. In the normal travel configuration, travel motors are at the rear of the machine, under the engine, and with the dozer blade to the front.

If the operator rotates the swing frame 180º, travel motors will be underneath the operator's cab, and operating travel will be reversed.

Use caution in reverse travel and swing frame rotation.

Use a signal person in high traffic areas and whenever the operator's view is not clear, such as when traveling in reverse.

Additional Travel Precautions

Swing frame control levers should not be operated while traveling.

Do not change selected travel mode (FAST/SLOW) while traveling.

Fold in work equipment so that the outer end of the boom is as close to the machine as possible, and is as low as possible (8"—12" [200 mm—300 mm]) to the ground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that would cause a tilt greater than 10º.

Snow, Ice and Cold Temperature Operation Precautions

In cold weather, avoid sudden travel movements and stay away from even very slight slopes. The machine can slide sideways on icy slopes.

Snow accumulation can hide potential hazards. Use care while operating and while using the machine to clear snow.

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FIRE HAZARDS

The machine has several components that operate at high temperature under normal operation conditions, primarily the engine and exhaust systems. Also, the electrical system, if not properly maintained or if damaged, can arc or produce sparks. These conditions make it extremely important to avoid circumstances where explosive dust or gases can be ignited by arcs, sparks or heat.

The machine must be cleaned on a regular basis to avoid the buildup of flammable debris such as leaves, straw, etc. Accumulated debris, particularly in the engine compartment, poses a fire hazard.

Add fuel, oil, antifreeze and hydraulic fluid to the machine only in a well ventilated area. The machine must be parked with controls, lights and switches turned off. The engine must be turned off before refueling or service checks are performed.

Static electricity can produce dangerous sparks at the fuel-filling nozzle. In very cold, dry weather or other conditions that could produce static discharge, keep the tip of the fuel nozzle in constant contact with the filler neck of the fuel tank, to provide a ground. Make sure that the static line is connected from the excavator to the service truck before fueling begins.

Keep fuel and other fluid reservoir caps tight and do not start the engine until caps have been secured.

Do not smoke while filling the fuel tank, while working on the fuel or hydraulic systems, or while working around the battery.

Take care to avoid spilling combustible fluids, such as oil or fuel, on a hot engine.

Fire Extinguisher Recommendation

It is recommended that a 5 lb. (2.27 kg) or larger, multi-purpose “A/B/C” fire extinguisher be mounted in the cab. Check the fire extinguisher periodically and be sure that work crew members are trained in its use.

After the machine has been parked properly, shut down the engine and cycle all controls to release any remaining hydraulic system pressure. Be sure all switches and operating controls are in the OFF position and the left-hand console is raised, locking out the hydraulic functions.

ADDITIONAL SAFETY EQUIPMENT

Severe operation may require use of additional safety equipment

Work in mines, tunnels, deep pits or on loose or wet surfaces could produce the hazard of falling rock, roll over or falling objects.

Any operator protective system installed on the machine must comply with applicable safety standards and carry appropriate labeling and rating information. For example, the cab of an excavator used in applications with falling object hazards must meet Society of Automotive Engineers Standard SAE J1356, “Performance Criteria for Falling Object Guards for Excavators.”

Never attempt to alter or modify the protective structure, by drilling holes, welding or re-locating fasteners. Any serious impact or damage to the system requires a complete integrity re-evaluation, and the replacement of the system may be necessary.

Install additional safety equipment if conditions require.

When working with a hydraulic breaker, a front guard over the windshield may be required.

Laminated glass or polycarbonate protection for the front, side or rear windows may also be recommended depending upon particular work conditions.

Contact your dealer for available safety guards and/or recommendations if there is any risk of being hit by objects that could strike the operator’s cab.

Eye Protection and Safety Clothing

Wear full eye protection, ear and head protection, safety shoes, gloves and any other protective clothing or equipment as needed while operating the machine.

Safety Equipment Maintenance

Machinery guards and body panel covers must be in place at all times. Keep clear of rotating parts, such as cooling fan and alternator belts, which could catch hair, jewelry or loose clothing.

All safety equipment must be maintained so it is always in good condition.

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Safety-critical parts must be periodically replaced. Replace the following potentially fire-sensitive components as soon as they begin to show signs of deterioration:

- Fuel system flexible hoses, fuel tank overflow drain hose and the fuel filler cap.
- Hydraulic system hoses, especially the pump outlet lines.

Keep mounting brackets and hose and cable routing straps tight. Hose routing should have gradual bends.

Breathing Masks and Ear Protection

Remember that some risks to your health may not be immediately apparent. Exhaust gases and noise pollution may not be visible, but these hazards can cause permanent injuries.

MAINTENANCE SAFETY

Only trained and authorized personnel, with a full awareness of safe procedures, should be allowed to operate or perform maintenance or service on the machine.

Use solid support blocking. Never rely on jacks or other inadequate supports when maintenance work is being done. Block tracks front and back to prevent any movement.

Keep fuel and other fluid reservoir caps tight. Do not start the engine until caps have been secured.

Never attempt to bypass the keyswitch to start the engine. Use only the proper jump-starting procedure according to See “Using a Booster Battery (Jump-Starting)” on page 4-17.

Never use hands to search for hydraulic fluid leaks. Instead, use a piece of paper or cardboard. Escaping fluid under pressure can be invisible and can penetrate the skin and cause serious injury. If any fluid is injected into your skin, see a doctor at once. Injected fluid must be surgically removed by a doctor or gangrene may result.

Always wear safety glasses with side shields when striking metal against metal. In addition, it is recommended that a softer (chip-resistant) material be used to cushion the blow, otherwise, serious injury to the eyes or other parts of the body could result.

Use care when seating retainer pins — retainer pins can fly out or splinter when struck and could cause injury.

Do not smoke or have any spark- or flame-producing equipment or materials in the area while filling the fuel tank or working on the fuel or hydraulic systems.

Do not attempt to loosen or disconnect any hydraulic lines, hoses, fittings, covers or caps without first relieving hydraulic circuit pressure. Relieve hydraulic pressure by performing the “Mandatory Safety Shutdown Procedure” on page 2-2. Be careful not to touch any hydraulic components that have been in recent operation, because they can be hot and cause burns.

Refer to the parts manual for information about assembly of components. Always use the correct parts and the proper torques — incorrect fastener connections can dangerously weaken assemblies.

Do not run the engine if repairs are being performed alone. There should always be at least two people working together if the engine must be run during service. Both persons must maintain visual contact with each other. Keep a safe distance away from all rotating and moving parts.

Always use the proper tools while working on the machine. Inappropriate tools could break or slip, causing injury, or they may not adequately perform intended functions.

Unless necessary for servicing the machine, do not open the engine cover while the engine is running.

Keep mounting brackets and hose and cable routing straps tight. Hose routing should have gradual bends.

After cleaning the machine, examine all fuel, lubricant and hydraulic oil lines for leaks, chafe marks and damage. Tighten any loose connections and repair or replace parts as necessary.

Use warning tag/control lockout procedures during service.

Alert others that service or maintenance is being performed and tag operator’s cab controls — and other machine areas if required — with a warning notice.

Don’t run the engine if repairs or work is being performed alone.

Do not run the engine if repairs or work is performed alone. There should always be at least two people working together if the engine must be run during service.

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Always use adequate equipment supports and blocking.

Lower bucket to the ground before leaving the operator's seat. Don't work under any equipment supported solely by a lift jack.

Track tension adjustments require caution.

NEVER fully remove the track tension grease fitting. To release pressure from the crawler frame track tension assembly, you should loosen the grease fitting slightly, no more than two turns.

Keep your face and body away from the fitting. Refer to "Checking and Adjusting Track Tension" on page 4-26.

Don't work on hot engines, cooling or hydraulic systems.

Wait for the engine to cool after normal operation. Park the excavator on a firm, level surface and lower all equipment before shutting down and switching off controls. When engine lube oil, gearbox lubricant or other fluids require changing, wait for fluid temperatures to decrease to a moderate level before removing drain plugs.

Temperatures below 120°F (49°C) will reduce the chances of scalding exposed skin while allowing the fluid to drain quickly and completely. However, do not let the fluid to fully cool, because drain time will be substantially increased.

Cool-down is required prior to radiator or hydraulic reservoir checks.

Stop the engine and allow it to cool before performing service on the engine radiator or hydraulic reservoir. Both assemblies have pressure vents at the filler cap for venting pressure. LOOSEN CAPS SLOWLY. Vent the pressure before removing the filler caps.

Release hydraulic system pressure by cycling controls and releasing hydraulic reservoir pressure before removing hydraulic reservoir access cover.

The hydraulic reservoir is pressurized. Vent the system pressure by rotating the filler cap. LOOSEN CAP SLOWLY prior to removal.

Make sure to release any hydraulic pressure stored in the lines by cycling the operator's controls in each direction after the engine has been shut down.

Pressurized hydraulic oil leaks can be hazardous.

Fluid leaks from hydraulic hoses and pressurized components can be difficult to see, but pressurized oil can have enough force to pierce the skin and cause serious injury.

Always use a piece of wood or cardboard to check for suspected hydraulic leaks. Never use your hands. Obtain immediate medical attention if pressurized oil pierces the skin. Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.

Use correct replacement fasteners tightened to proper torque.

Refer to the Parts Manual for information on torques and assembly of components.

IMPORTANT

Always use the correct, original-equipment parts. Incorrect fastener connections can dangerously weaken assemblies.

Dispose of all petroleum-based oils and fluids properly.

Dispose of all petroleum-based oils and fluids properly. Used motor oil may pose a health risk. Wipe oil from your hands promptly and wash off any residue. Used motor oil is an environmental contaminant and may only be disposed of at approved collection facilities. Never drain any petroleum-based product on the ground or dispose of used oil in municipal waste collection containers, or in metropolitan sewer systems or landfills. Check state and local regulations for other requirements.

When handling oil, grease and other chemical substances, follow the product-related safety requirements (Material Safety Data Sheet (MSDS) carefully to prevent burning or scalding yourself or other persons.

Safety Decals

Safety decals must be replaced if they become unreadable. Safety decal mounting locations are shown starting on page 2-11.

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Hydraulic Cylinder Seal Periodic Replacement

Check cylinder drift rate at regular intervals. Maximum allowable rates are included at the end of the Hydraulic section in the Excavator Service Manual. Overhaul seal kits are available through Manitou Americas, Inc..

High Pressure Hydraulic Lines Store Energy

Exposed hydraulic hoses on the arm or boom could react with explosive force if struck by a falling rock, overhead obstacle or other job site hazard. Extra safety guards may be required. NEVER allow hoses to be hit, bent or interfered with during operation.

Operator's Cab and Swing Frame Deck Maintenance

Cleaning off accumulations of grease and dirt helps extend equipment service life. Cleaning also provides an opportunity to inspect equipment. Minor damage can be repaired or corrected before major problems result.

Battery Electrolyte and Explosive Gas Hazard

Flush eyes with water for 10-15 minutes if battery acid is splashed in the face. Anyone who swallows acid must have immediate medical aid. Call the Poison Control center listing in the telephone directory.

Sparks can set off explosive battery gas from incidental contact or static discharge. Turn off all switches and the engine when working on batteries. Keep battery terminals tight. Contact between a loose terminal and post can create an explosive spark.

Battery Disconnection Precaution

Remove cable to negative terminal first when disconnecting a battery. Connect positive terminal cable first when installing a battery.

Jump-starting or Charging the Battery

Turn off all electrical equipment before connecting leads to the battery, including electrical switches on the battery charger or jump-starting equipment.

When jump-starting from another machine or vehicle, do not allow the machines to touch. Wear safety glasses or goggles while battery connections are made.

Batteries contain acid and produce explosive gases. Keep sparks, flames and lit cigarettes away from batteries at all times.

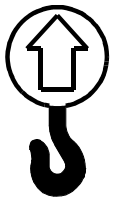
Connect positive cable first when installing jumper cables. The final cable connection, at the metal frame of the machine being charged or jump-started, should be as far away from the batteries as possible.

Disconnect the negative cable first when removing the jumper cables. For specific jump-starting instructions refer to Page 4-17 in the Maintenance chapter of this manual.

LIFTING THE MACHINE WITH A CRANE

Only lift the machine according to the following guidelines:

- The crane and rigging equipment must have sufficient capacity. See "Lifting the Machine" on page 3-31.
- Lift the machine according to "Lifting the Machine" on page 3-31.
- Secure the machine against unintentional movement. Use taglines as needed.
- Do not lift the machine with persons on or in the machine.
- Any person guiding the crane operator must be within sight or sound of the crane operator.
- Lift the machine only with the standard bucket installed, the bucket empty and in the transport position.
- Persons must stay clear of and not under the machine when it is lifted.
- Fasten the rigging equipment so the machine is horizontal when it is lifted.
    - Do not lift the machine by the eye hooks on the cab. Attach the rigging equipment only at the lift points identified by this symbol:



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TRANSPORTING

Obey state and local over-the-road regulations. Check state and local restrictions regarding weight, width and length of a load. The hauling vehicle, trailer and load must all be in compliance with local regulations. Refer to the Transporting section of this manual.

SAFETY DECALS

The machine has decals shown on the following pages that provide safety information and precautions. These decals must be kept legible. If missing or illegible, they must be replaced promptly. Replacements can be obtained from your dealer.

Refer to the Parts Manual for decal part numbers and ordering information.

New Decal Application

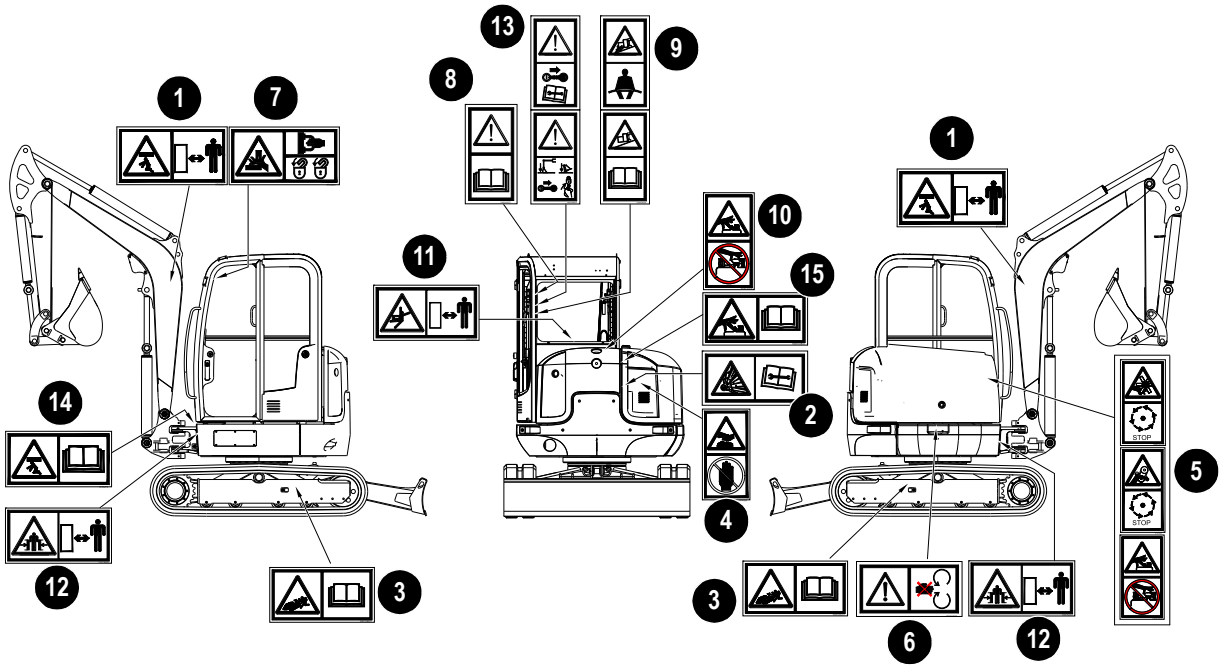
Surfaces must be free of dirt, dust, grease and foreign material before applying the decal. Remove the smaller portion of the decal backing paper and apply the exposed adhesive to the clean surface, maintaining proper position and alignment. Peel the rest of the backing paper and apply hand pressure to smooth out the decal surface. Refer to the following pages for proper decal locations.

If replacing a part that has a decal on it, ensure that the replacement part has the same decal.

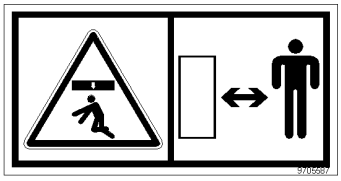
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ISO-Style Safety Decal Locations (Serial Numbers AG04058 and Up)



1



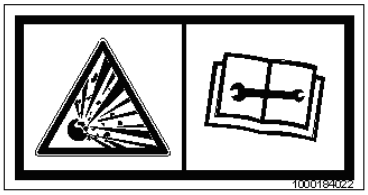
WARNING! Danger Zone Decal

AVOID INJURY OR DEATH!

Located on both sides of the boom.

Keep bystanders away from the machine when it is in use.

2



WARNING! Hydraulic Reservoir Under Pressure

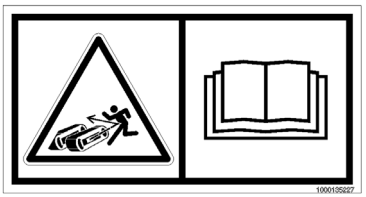
AVOID INJURY OR DEATH!

Located on the hydraulic system accumulator bulb inside the engine compartment.

Relieve hydraulic pressure before servicing machine. Removed hydraulic reservoir cap slowly.

Refer to the maintenance section in the operator's manual before servicing the machine.

3



WARNING! Stay Clear Decal

AVOID INJURY OR DEATH!

Located next to the track tension grease fitting on both sides of the machine.

WARNING! Grease is under high pressure. Keep your face and body away from the fitting.

Do not loosen the fitting more than two turns. Do not loosen parts other than the fitting.

Refer to the operator's manual for track adjustment procedure.

4



WARNING! Hot Surfaces Decal

AVOID SERIOUS INJURY!

Located inside the engine compartment.

Stop the engine and wait for all parts to cool before opening the engine compartment. Hot surfaces can cause severe burns.

Read the operator's manual before performing any maintenance on the machine.

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5



WARNING! Rotating and Hot Components Decal

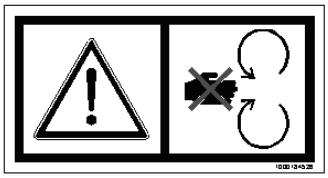
AVOID SERIOUS INJURY!

Located on the fan shroud inside the engine compartment.

Stop the engine and wait for all parts to cool before opening the engine compartment. Rotating parts can cause severe injury. Hot surfaces and liquids can cause severe burns.

Read the operator's manual before performing any maintenance on the machine.

6



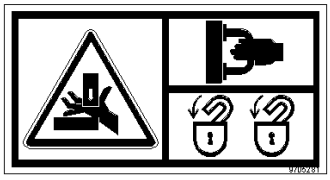
WARNING! Rotating Components! Danger of Entanglement! Decal

AVOID SERIOUS INJURY!

Located below the engine cover latch.

Stop the engine before opening the engine compartment. Rotating parts can cause severe injury.

7



WARNING! Crushing Hazard Decal

AVOID SERIOUS INJURY!

Located on the inside of the front window on cab-equipped machines.

Only open and close the front window using the handles.

Always lock the front window using both locks.

8



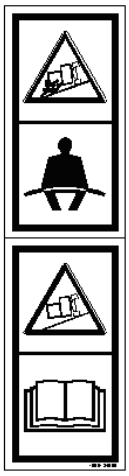
WARNING! Read Operator's Manual

AVOID INJURY OR DEATH!

Located on the door pillar inside the cab.

Read the operator's manual before operating or performing any maintenance on the machine.

9



WARNING! Decal

AVOID INJURY OR DEATH!

Located on the door pillar inside the cab.

No riders! Never use work tool as work platform.

Operate only from operator's seat.

ALWAYS wear seatbelt.

WARNING: Avoid Overturn

Side stability is reduced when: 1) turning; 2) operating on rough terrain or side slopes; and 3) carrying load raised.

Carry load low. Do not exceed Rated Operating Capacity.

Avoid steep slopes and high speed turns.

Travel up and down slopes with heavy end uphill.

Read the operator's manual before operating the machine.

10



WARNING! Hot Components Decal

AVOID SERIOUS INJURY!

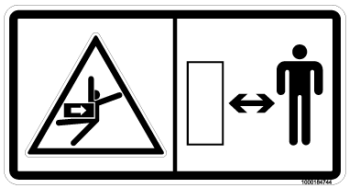
Located next to the hydraulic system filler cap.

Stop the engine and wait for all parts to stop and cool before. Hot surfaces and liquids can cause severe burns.

Read the operator's manual before performing any maintenance on the machine.

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(11)



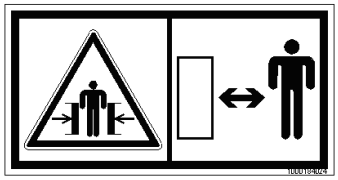
WARNING! Danger Zone Decal

AVOID INJURY OR DEATH!

Located on the back of the swing frame.

Keep bystanders away from the machine when it is in use.

(12)



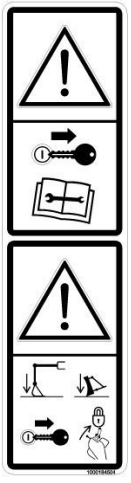
WARNING! Danger Zone Decal

AVOID INJURY OR DEATH!

Located on both sides of the boom swivel bracket.

Swiveling boom can cause crushing. Keep bystanders away from the machine when it is in use.

(13)



WARNING! Mandatory Safety Shutdown Decal

AVOID INJURY OR DEATH!

Located on the door pillar inside the cab.

Before leaving the machine, or performing any service on the machine, perform the "Mandatory Safety Shutdown Procedure" on page 2-2.

1. Lower the working equipment to the ground and support it securely.

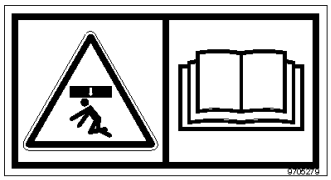
2. Run the engine at idle speed for a few minutes to allow systems to cool after operation at full speed.

3. Turn the key fully counter-clockwise to shut off the engine.

4. Lock out controls by raising left control console.

5. Remove the ignition key and take it with you.

(14)



WARNING! Danger Zone Decal

AVOID INJURY OR DEATH!

Located next to the boom swivel bracket.

Keep bystanders away from the machine when it is in use. Read the operator's manual before operating the machine.

(15)



WARNING! Hot Components Decal

AVOID SERIOUS INJURY!

Located inside the engine compartment.

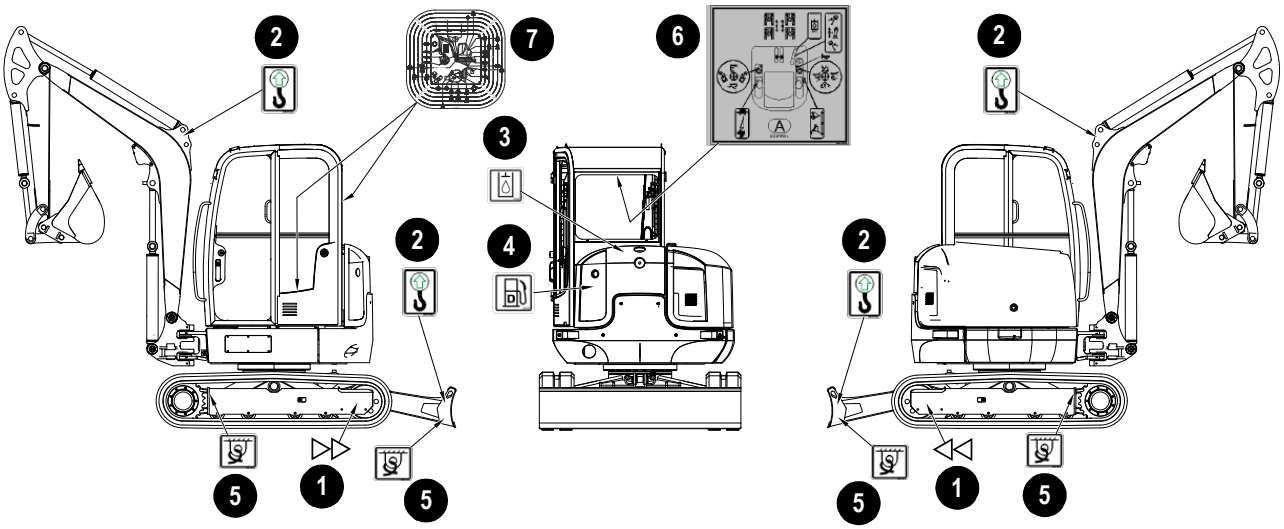
Stop the engine and wait for all parts to stop and cool before. Hot surfaces and liquids can cause severe burns.

Read the operator's manual before performing any maintenance on the machine.

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ISO-Style Information Decal Locations (Serial Numbers AG04058 and Up)



1 **Track Front Decal**



Located near the front of the track frame on both sides of the machine

Indicates the front of the track frame.

2 **Lift Point Decal**



Located on both sides of the boom on the dipper arm cylinder bracket, and on both ends of the dozer blade.

Apply lift hooks only in these locations.

3 **Hydraulic Fluid Decal**



Located next to the hydraulic system filler cap.

USE HYDRAULIC FLUID ONLY!

4 **Diesel Fuel Decal**



USE DIESEL FUEL ONLY! Located next to the fuel filler neck.

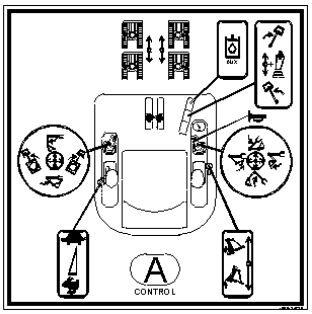
5 **Tie-Down Point Decal**



Located on both ends of the dozer blade and near the rear end of the track frame on both sides of the machine.

Only use tie-down points to secure the machine during transport.

6



Operator Controls Decal

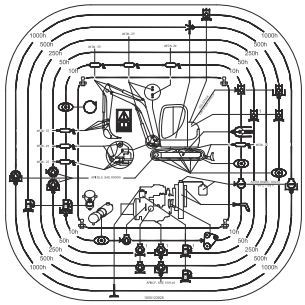
Located on the ceiling inside the cab.

Provides quick-reference for the SAE operator's control option inside the cab.

Read the operator's manual before operating the machine. Refer to the operator's manual for details about the operator's controls.

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7



Maintenance Decal

Located on the back window of the cab.

Provides maintenance intervals quick-reference.

Read the operator's manual before maintenance on the machine. Refer to "Maintenance Schedule" on page 4-5.

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ANSI-Style Safety Decal Locations (Serial Numbers AG04057 and Before)

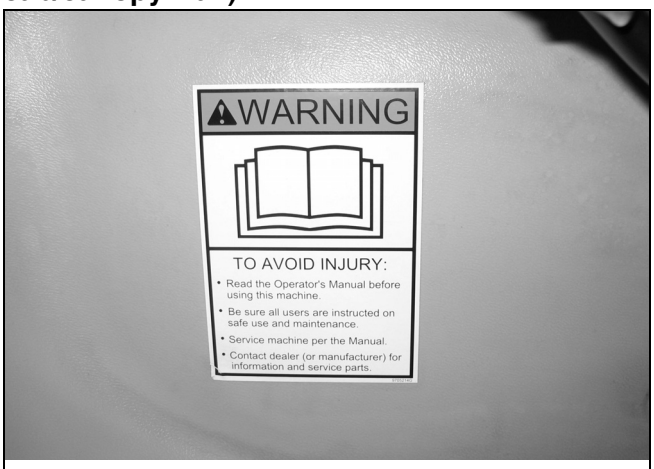
Swing Radius Warning Decal (both sides of boom)



WARNING

DANGER ZONE Keep away!

Read Operator's Manual Decal inside right of cab/canopy wall)



WARNING

TO AVOID INJURY:

- **Read the Operator's Manual before using this machine.**
- **Be sure all users are instructed on safe use and maintenance.**
- **Service machine according to the operator's manual..**
- **Contact dealer (or manufacturer) for information and service parts.**

Hydraulic Pressure Warning Decal (top of tank cover)



WARNING

Hydraulic Reservoir Under Pressure

Operation/Warning Decal (cab/canopy ceiling)



WARNING

TO AVOID INJURY:

1. **Load and transport unit properly. Inspect job-site for hazards.**
2. **Operate only from operator's seat. Fasten seat belt.**
3. **Keep people out of DANGER ZONE.**
4. **Operate within stability limit of machine. DO NOT OVERLOAD. Use only approved attachments.**

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Shutdown/Warning Decal (cab/canopy ceiling)



WARNING

TO AVOID INJURY:

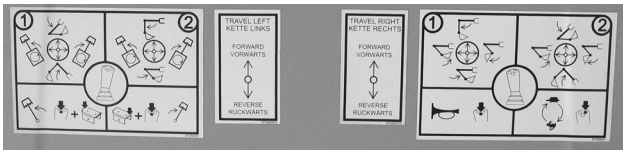
1. Lower all equipment to ground.

2. Reduce throttle; shut off engine.

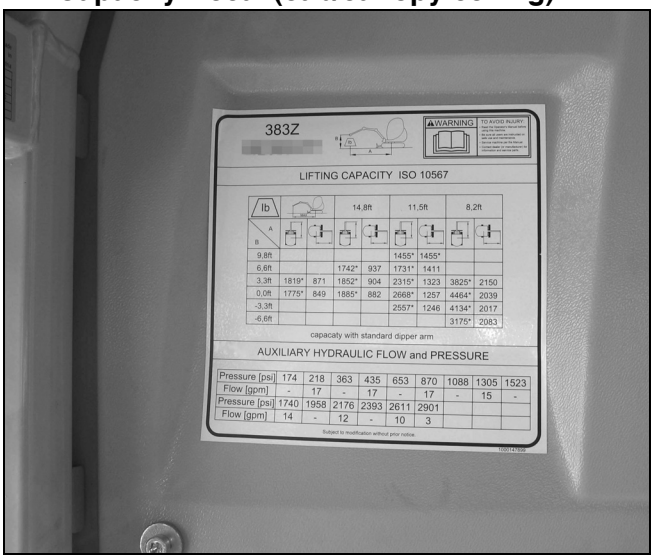
3. Lock-out controls before exiting.

4. Remove key and take it with you.

Operation Decals (cab/canopy ceiling)



Lift Capacity Decal (cab/canopy ceiling)



Track Tensioner Warning Decal (track frame — both sides)

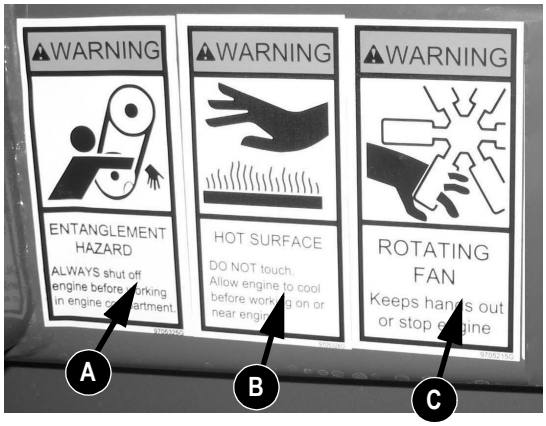


WARNING

AVOID INJURY:

Do not loosen lubricator more than 2-3 turns. Do not loosen parts other than adjustment fitting. Keep to the side when loosening the adjustment fitting. Grease is under high pressure and adjustment fitting can be ejected at high speed.

Entanglement, Rotating Fan and Hot Surface Warning Decals (inside engine compartment)



A – WARNING: ENTANGLEMENT HAZARD – ALWAYS shut off engine before working in engine compartment.

B – WARNING: HOT SURFACE – DO NOT touch. Allow engine to cool before working on or near engine.

C – WARNING: ROTATING FAN – Keep hands out or stop engine.

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Cab Tilt Warning Decal (under cab/canopy)



WARNING

TO AVOID INJURY OR DEATH:

Read the Operator's Manual before reaching or leaning under tilted cab.

Pinch Point Decal (above inside windshield [cab unit only])

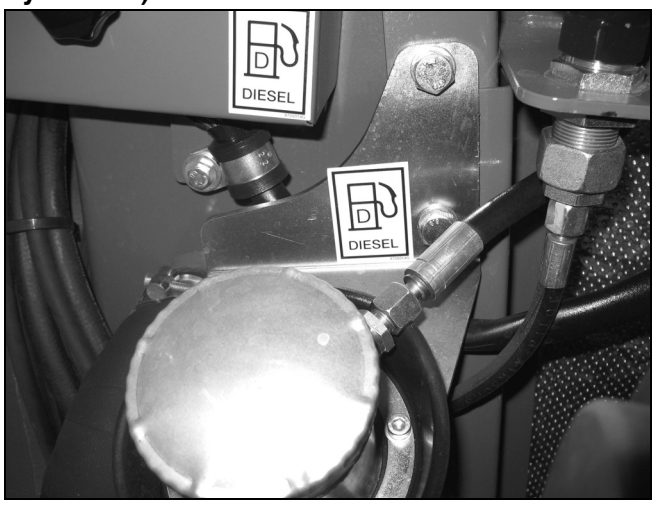


WARNING

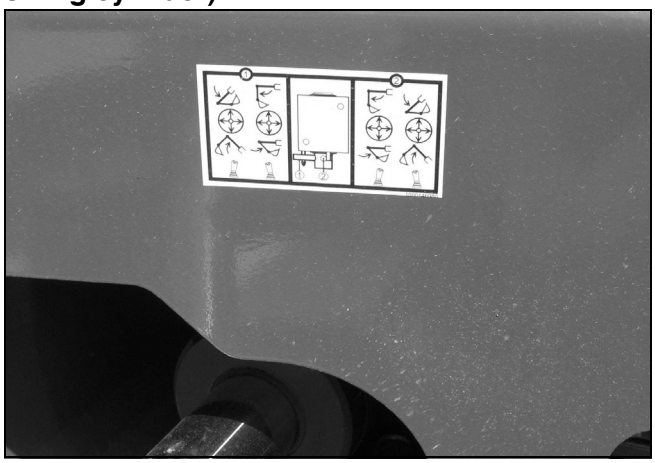
TO AVOID INJURY:

- **ALWAYS hold handle when closing front window.**
- **When opening window, be sure to lock both sides.**

Diesel Fuel Decal (inside engine compartment by fuel fill)

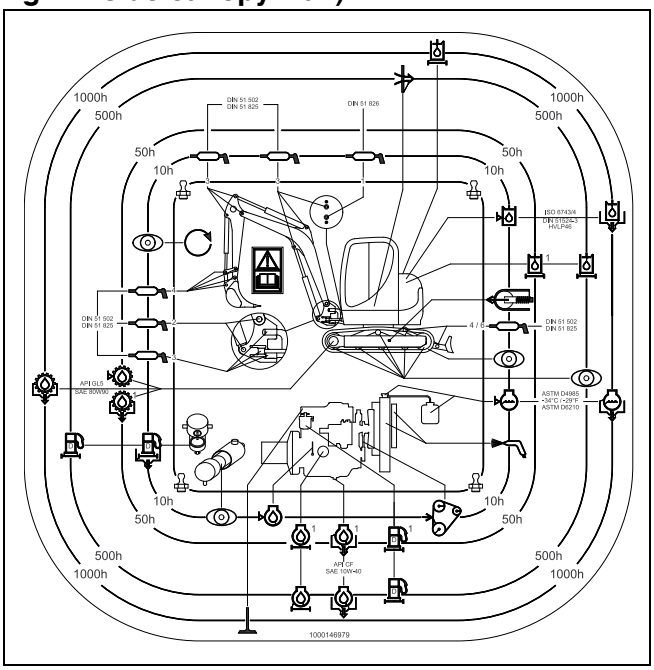


SAE/ISO Control Decal (front of unit next to swing cylinder)



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Lubrication Chart Decal (cab back window/ right inside canopy wall)



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NOTES

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CHAPTER 3 – OPERATION

OPERATING CONTROLS

⚠ WARNING

- **Read and understand this entire manual. Follow warnings and instructions for operation and maintenance. Failure to follow instructions can result in injury or death.**
- **Read and understand all safety decals before operating the machine. DO NOT operate the machine unless all factory-installed guards and shields are in place.**
- **Be sure you are familiar with all safety devices and controls before operating the machine.**
- **Know how to stop the machine before starting.**
- **Use only with approved accessories or referral attachments. The manufacturer cannot be responsible for safety if the unit is used with non-approved attachments.**
- **Check for correct function after adjustments or maintenance.**

Machine Orientation

All references to “right” and “left” are determined from the operator's position facing forward.

Guards and Shields

Whenever possible, guards and shields are used to protect potentially hazardous areas on the machine. In many places, decals are also provided to warn of potential hazards or to display special operating procedures (see *Chapter 2 – Safety*).

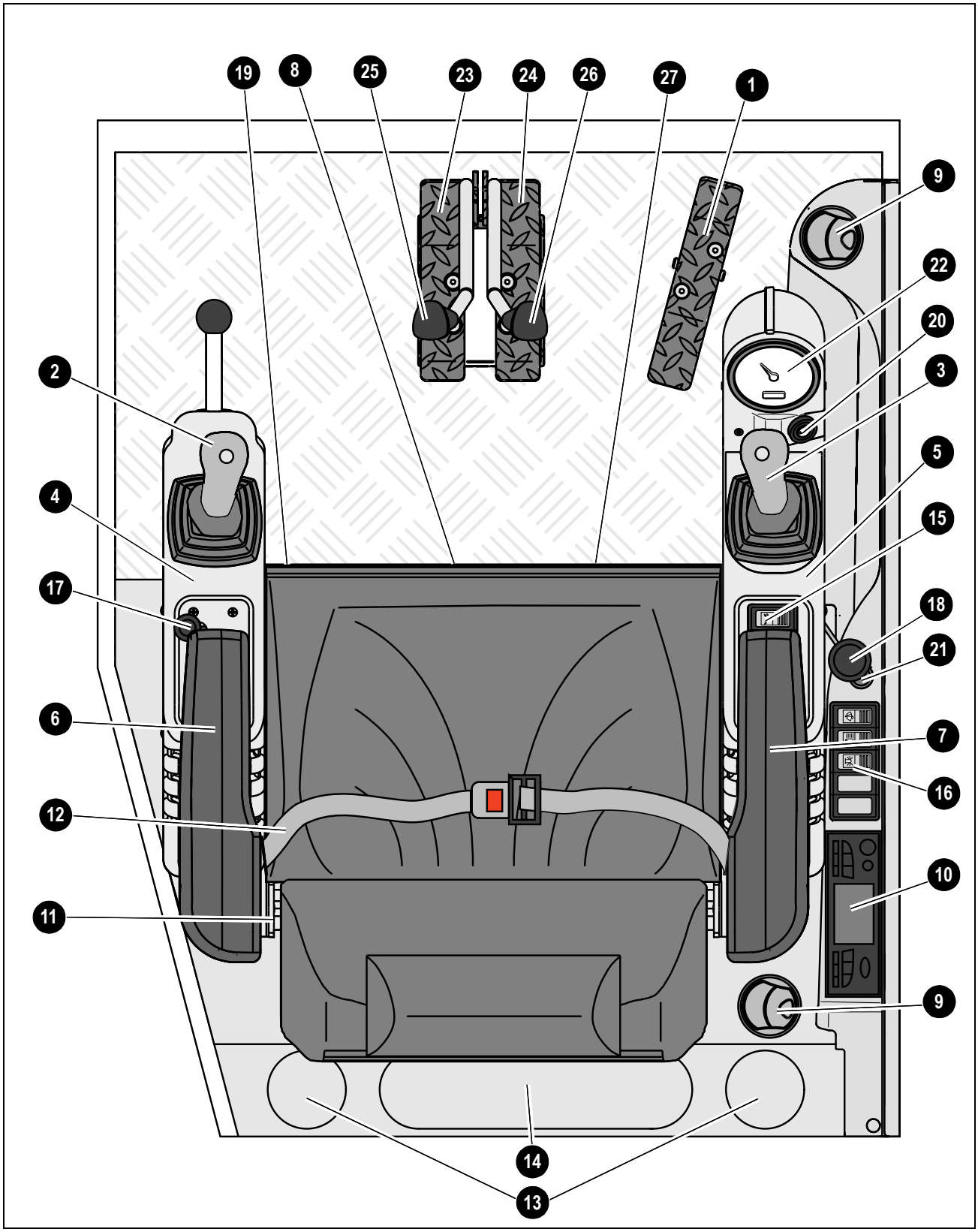
The left operator’s console should be raised to enter and exit the cab. In the raised position, the console locks out all hydraulic functions of the machine. See Figure 3-1.



Figure 3-1 Operator’s Left Console in Lock-out Position

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Figure 3-2 Equipment and Controls

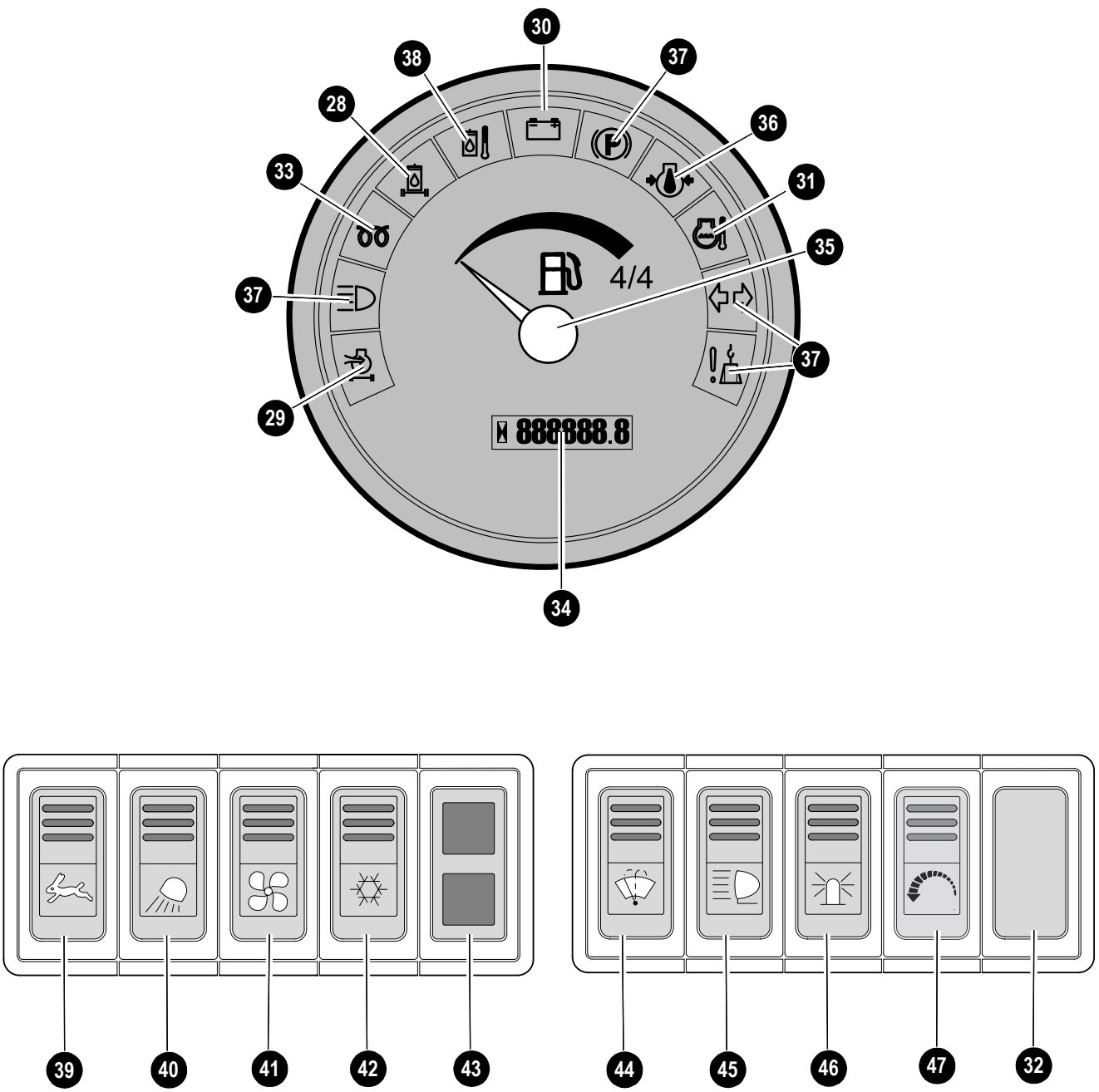


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Pos.	Description	For more information see page
1	Boom Swivel Pedal	3-12
2	Joystick (left)	3-9
3	Joystick (right)	3-9
4	Control Lever Base (left)	
5	Control Lever Base (right)	
6	Armrest (left)	
7	Armrest (right)	
8	Seat Horizontal Adjustment Lever	3-13
9	Air Vent (cab only)	
10	Radio (option)	
11	Seat Backrest Adjustment	3-13
12	Seat Belt Latch	3-13
13	Cup Holder	
14	Bracket (storage box for documents)	
15	Switch Panel	
16	Switch Panel	
17	Throttle Lever	3-11
18	Dozer Blade Lever	3-12
19	Fuse Box	3-12
20	Preheating/Ignition Switch	3-7
21	Accessory Power Outlet	
22	Instrument Cluster	
23	Drive Pedal (left)	3-8
24	Drive Pedal (right)	3-8
25	Drive Lever (left)	3-8
26	Drive Lever (right)	3-8
27	Heater Control (cab only)	3-15

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Figure 3-3 Instrument Panel, Switches and Indicators

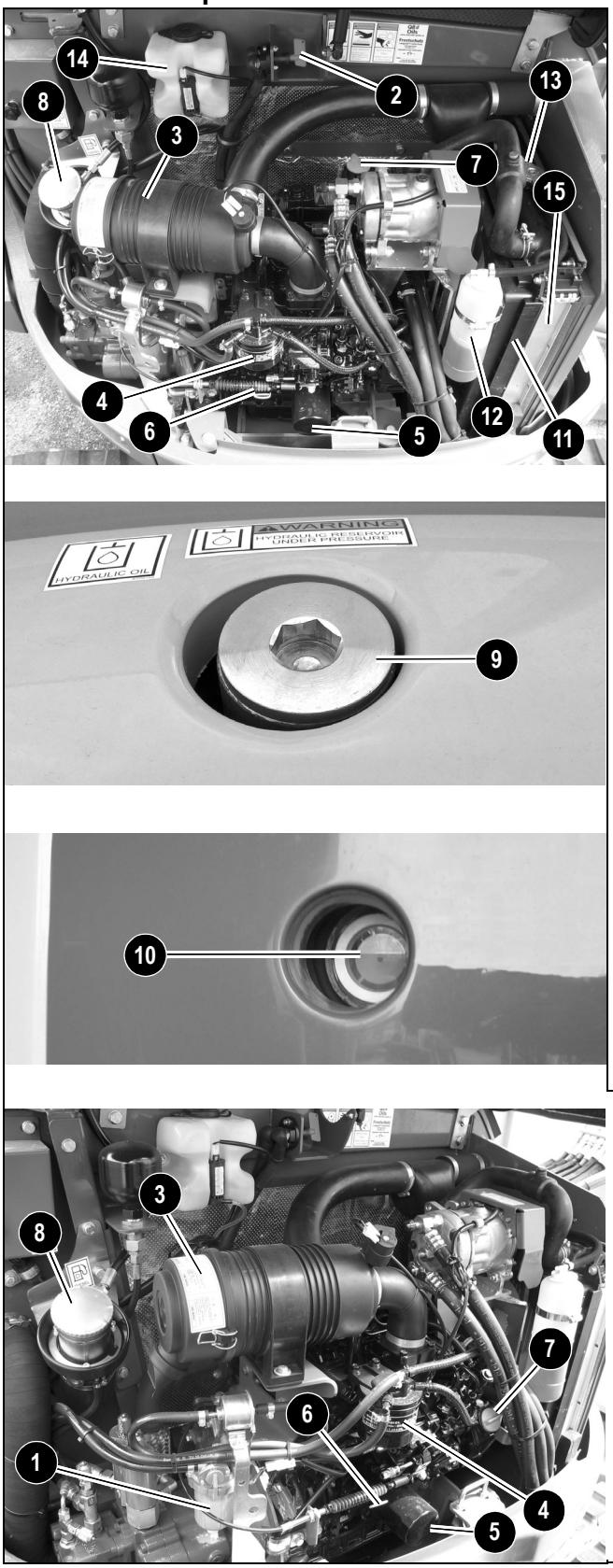


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Pos.	Description
28	**Hydraulic oil filter indicator (red)** – Hydraulic oil filter indicator light comes on when hydraulic oil filter requires servicingor while the hydraulic oil is cold.
29	**Engine air filter indicator (red)** – Air filter indicator light comes on when air filter requires servicing.
30	**Battery charge fault indicator (red)** – Battery charge indicator light comes on when the ignition is turned on and goes off when the engine starts. If the indicator light comes on while the engine is running, the battery is not charging, indicating a faulty charging circuit in the alternator or problems with the V-belt. **NOTE:** a faulty V-belt affects cooling pump operation, which can lead to overheating and more serious engine problems. Shut off the engine IMMEDIATELY and determine the cause if this indicator comes on when the engine is running.
31	**Engine coolant temperature indicator (red)** – Coolant temperature indicator light comes on if coolant temperature rises above specification.
32	**Not assigned**
33	**Glow plug indicator (yellow)** – Glow plug indicator light comes on when the ignition key is in the glow plug activation position. Indicator will go out when the glow plugs have heated sufficiently to start the engine.
34	**Hourmeter** – Indicates the total operating hours of the machine. Use the hourmeter to track maintenance in the maintenance log.
35	**Fuel level gauge** – The fuel level gauge shows the amount of fuel in the tank.
36	**Engine oil pressure indicator (red)** – Engine oil pressure light comes on when the ignition is turned on and goes off as soon as the engine is running. During normal operation, this indicator should remain off. The indicator will light if the engine oil pressure drops too low. If this occurs, shut off the engine IMMEDIATELY and determine the cause of the pressure drop.
37	**Indicator light** – Not assigned
38	**Hydraulic oil temperature indicator light** – Hydraulic oil temperature indicator light comes on when hydraulic oil is too hot.
39	**High-speed switch (transport speed)** – Pressing the switch will enable high travel speed.
40	**Work light switch** – Press switch to the ON position to turn on the boom work light.
41	**Ventilation fan (two-speed)** – Press the two-position switch to turn on the ventilation fan. Pressing switch to the first position is the low fan speed position, and the second position is the high fan speed position. If the heater control (cab model only) is in the heating position, this switch functions as the cab heater ON/OFF switch.
42	**Air conditioning (option, cab only)** – Press the switch to turn on the air conditioning.
43	**Proportional control status indicator (option)** – Indicates proportional control operation.
44	**Windshield wiper switch (cab models only)** – Pressing the two-position switch to the first position turns on the windshield wiper. Pressing and holding the switch indicator in the second position activates the washer fluid pump.
45	**Roof lights (option)** – Press switch to the ON position to turn on the roof light lights.
46	**Rotating beacon (option)** – Press switch to the ON position to turn on the boom work light.
47	**Auto-idle switch (option)** – Enables optional auto-idle feature. See page 3-11.

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Excavator Components



1. Fuel/water separator
2. Battery disconnect switch
3. Air cleaner
4. Fuel filter
5. Engine oil filter
6. Engine oil dipstick
7. Engine oil fill (2 places)
8. Fuel filler cap
9. Hydraulic fluid filler cap
10. Hydraulic fluid level sight gauge
11. Radiator
12. Radiator overflow reservoir
13. Radiator cap
14. Windshield washer reservoir (cab only)
15. Hydraulic oil cooler
16. Battery (located under cab)

Figure 3-4 Excavator Components

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Ignition Key Switch

Note: *The engine can only be started if the left control lever console is pivoted down into the operation position.*

With the key in the fully counter-clockwise “P” position, all power is shut off. The key can be inserted or removed when the switch is in this position.

With the key in the “0” position, power to the accessory circuit is turned on. The key can be inserted or removed when the switch is in this position.

With the key in the “I” position, power is turned on to all controls and electrical circuits. The battery charge indicator light and the oil pressure indicator light will come on.

With the key in the “II” position, the glow plug indicator will come on while the glow plugs warm intake air in cold weather.

With the key turned fully clockwise “III” and held in position, the engine will crank/start. The indicator lights should go out when the engiine starts. Release the key after the engine starts (the key returns to the “I” position when it is released after starting the engine).

Note: *The key must always be returned to the “I” position between attempts to start the engine in order to activate the glow plug system.*

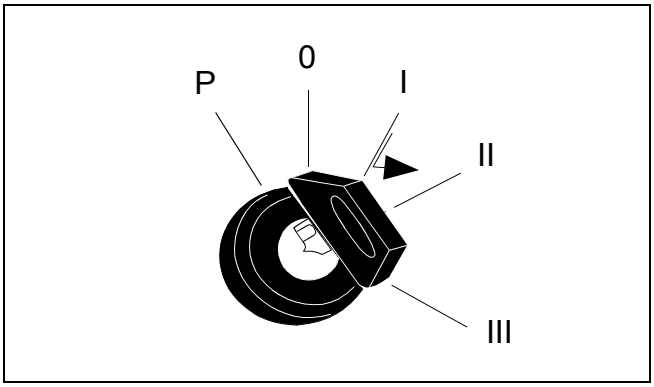


Figure 3-5 Ignition Key Switch

Battery Disconnect Switch

A battery disconnect switch is located in the engine compartment under the hood. The switch allows electrical lockout of all functions of the excavator. See Figure 3-6. To disconnect battery and lockout all electrical functions, turn key (1) of the battery disconnect switch counter-clockwise to position (2) and remove it. To reconnect battery and turn on all electrical functions, insert key (1) into the battery disconnect switch and turn clockwise to the notched position (3).

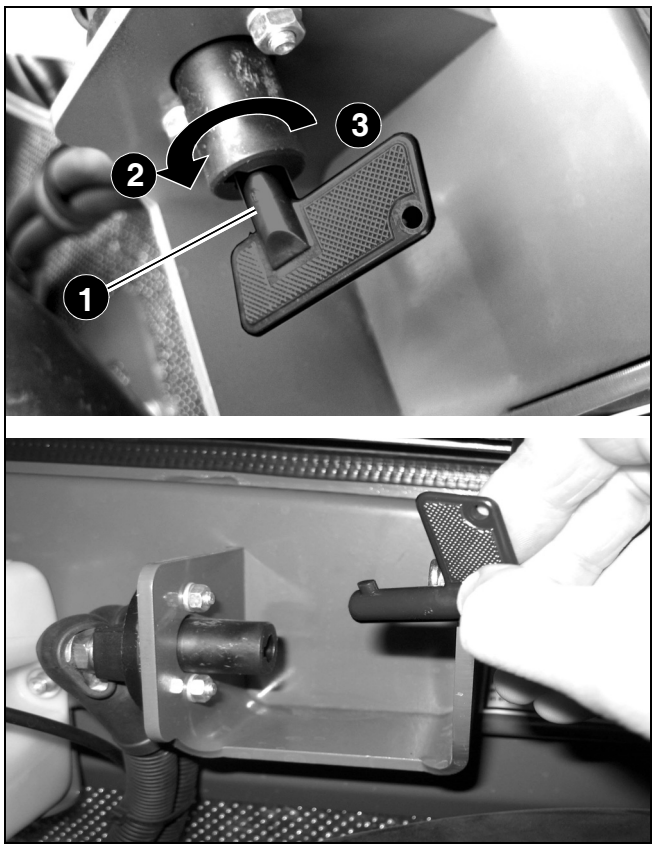


Figure 3-6 Battery Disconnect Switch

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Travel Controls

⚠ WARNING

- **Levers and controls should return to neutral position when released.**
- **Be sure the levers and controls are in the neutral (middle) position before starting the engine.**
- **Operate controls gradually and smoothly. Excessive speed and quick control movements without regard for conditions and circumstances are hazardous and could cause an accident.**

⚠ WARNING

Be sure that the dozer blade is "in front." When the operator's cab is facing forward, the blade will be visible and travel controls will operate as expected. If the dozer blade is not visible, the operator's cab is facing to the rear, and the travel controls will operate in reverse.

Forward Travel

Both travel control levers or pedals must be moved forward. The farther they are moved forward, the faster the machine will travel. See Figure 3-7.

Reverse Travel

Both travel control levers or pedals must be moved rearward. The farther they are moved rearward, the faster the machine will travel. See Figure 3-7.

Turning During Travel

Pivot (wide) turns are made by rotating only one track forward or rearward so the machine pivots on the stationary track. **Spin turns** are made by rotating one track forward and one track rearward. The machine will spin around its mid-point. See Figure 3-7.

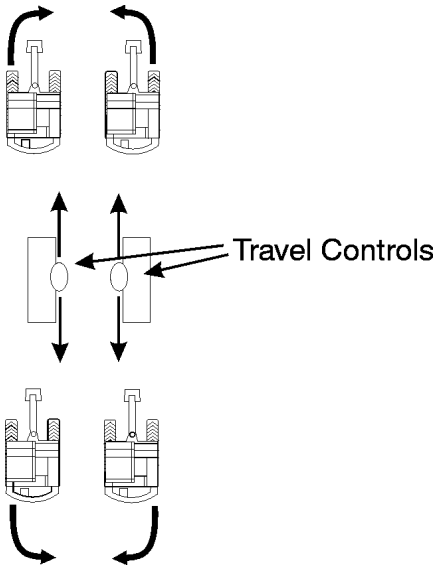


Figure 3-7 Travel Controls

Spin Turn

Move the levers in opposite directions to spin the machine on its axis. To spin turn left, move the right control lever forward while pulling the left control lever to the rear; to spin turn right, move the left control lever forward while pulling the right control lever to the rear. See Figure 3-8.



Figure 3-8 Operator's Position and Joystick Controls

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SAE/ISO Selector

See page 3-11.

SAE Operating Controls

SAE boom and bucket functions are controlled by the right and left joystick control levers located on the seat consoles.

SAE Left Joystick – See Figure 3-9.

1 – Arm extend
2 – Arm retract
3 – Swing left
4 – Swing right

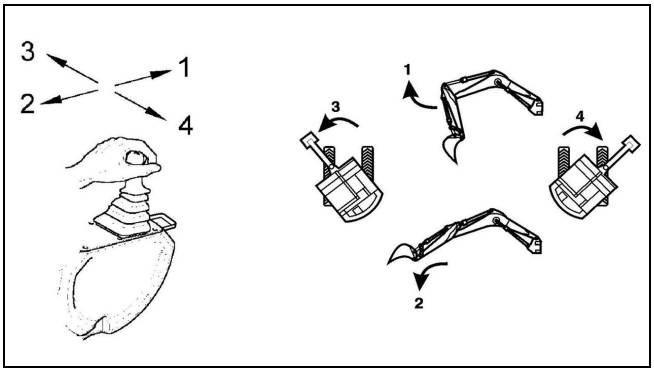


Figure 3-9 SAE Left Joystick

SAE Right Joystick – See Figure 3-10.

5 – Boom lower
6 – Boom raise
7 – Curl bucket in
8 – Curl bucket out

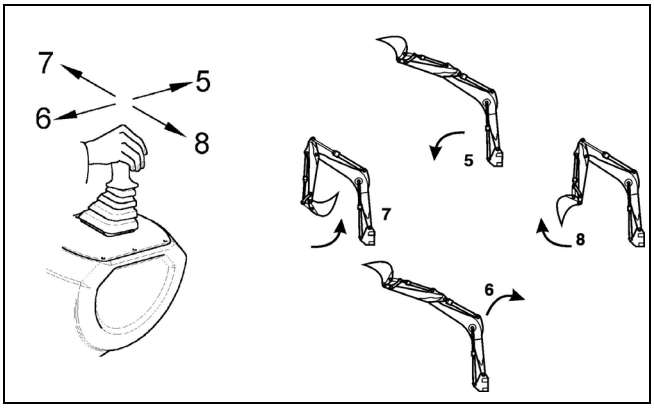


Figure 3-10 SAE Right Joystick

Note: *The joystick controls are pilot-operated. The farther the controls are moved from center, the faster the machine will function.*

ISO Operating Controls

ISO boom and bucket functions are controlled by the right and left joystick control levers located on the seat consoles.

ISO Left Joystick – See Figure 3-11.

1 – Boom lower
2 – Boom raise
3 – Swing left
4 – Swing right

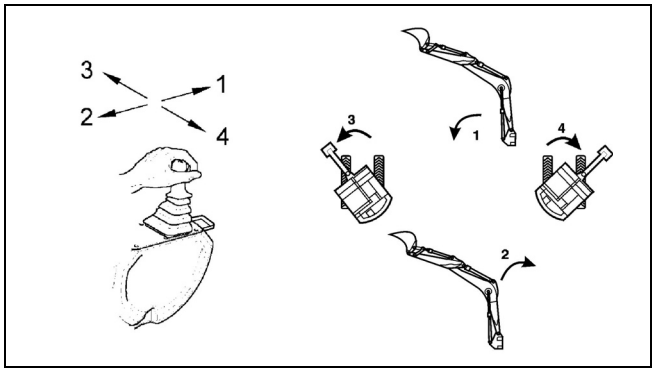


Figure 3-11 ISO Left Joystick

ISO Right Joystick – See Figure 3-12.

5 – Arm extend
6 – Arm retract
7 – Curl bucket in
8 – Curl bucket out

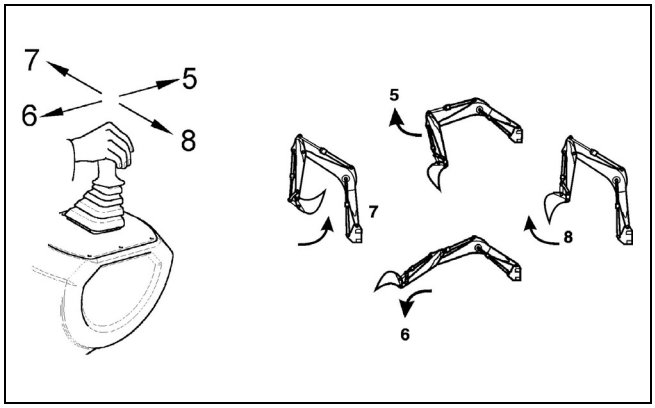


Figure 3-12 ISO Right Joystick

Note: *The joystick controls are pilot-operated. The farther the controls are moved from center, the faster the machine will function.*

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Tilting the Cab or Canopy

⚠ WARNING

- **Always tighten cab lock-down nuts before driving or using the machine.**
- **Always close the cab door before tilting the cab.**
- **Stay clear from underneath the cab as it is tilted.**
- **Always secure the tilt rod in the support position when the cab is tilted.**

Refer to items 1-11 in Figure 3-13 to safely complete the following procedure.

Tilting the cab or canopy up:

1. Follow "Mandatory Safety Shutdown Procedure" on page 2-2.
2. Raise the floor mat (1) on the right, front of the cab and remove cab lock-down nut (2). Remove cab lock-down bolt (3) at the right rear of the cab.
3. Securely close the cab door.
4. Locate the jack handle tubes (4) from the tool kit in the engine compartment, insert them into the jack (5) and extend the jack as far as it will go. The cab will be raised as far as the jack (5) will travel.
5. Pull on handle (7) until the cab is completely tilted and supported by the safety cable (8).
6. Remove the tilt support (9) from the storage bracket (10) and slide the tilt support into the guide bracket (11) and secure with the retention pin.

Tilting the cab or canopy down:

1. Remove the tilt support (9) from the guide bracket (11) by removing the retention pin and slide the tilt support out of the guide bracket. Secure the tilt support into the storage bracket (10). Replace the retention pin back into the guide bracket for storage.
2. Use handle (7) to slowly lower the cab back onto the jack.
3. Remove jack handle tubes (4) from the jack and insert the opposite end of the jack handle tubes onto the release pin (6). Slowly twist the release pin counter-clockwise until the cab is lowered.
4. Turn the release pin (6) clockwise.
5. Reinstall the cab lock-down nuts (2) and (3).
6. Place the jack handle tubes (4) back in the tool kit.

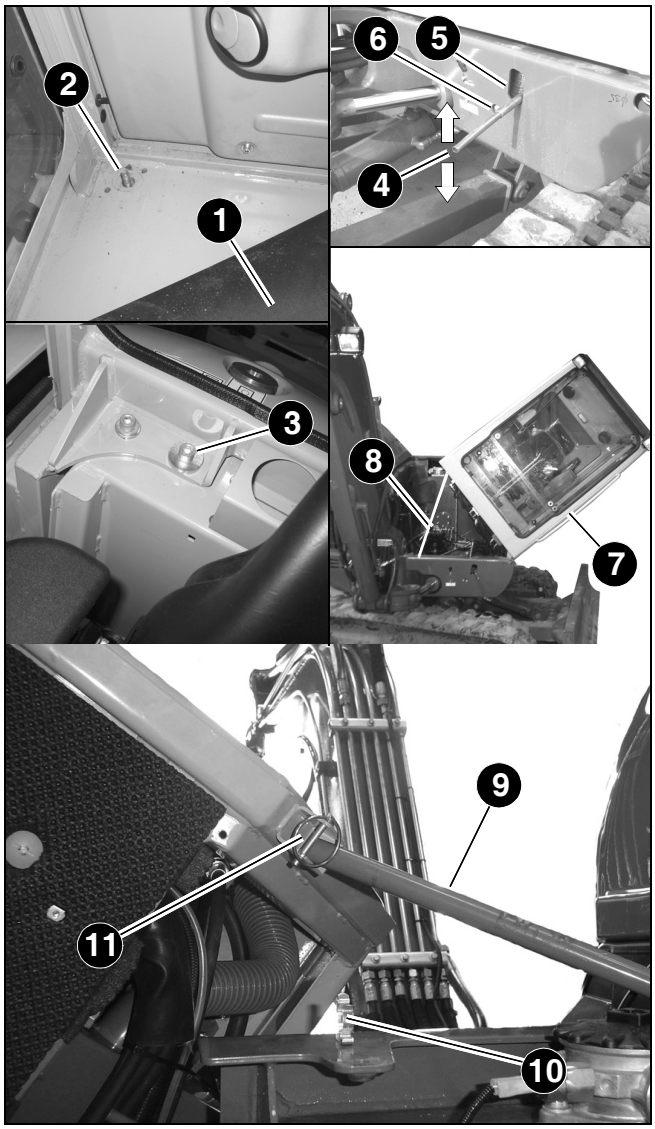


Figure 3-13 Tilting the cab or canopy

⚠ CAUTION

Check the tilt support (9), retention pin (11) and safety cable (8) at regular intervals for cracks and cuts. Replace defective parts immediately.

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SAE/ISO Operating Controls Selector

Note: *See page 3-9 for SAE/ISO joystick operation.*

The SAE/ISO selector is located inside the front of the chassis at the top of the swing cylinder opening. See (1), Figure 3-14. The machine has been set at the factory for SAE standard operation shown in the top photograph. If ISO operation is desired, loosen wing nut (2) and rotate to the position in the bottom photograph and retighten wing nut (2).

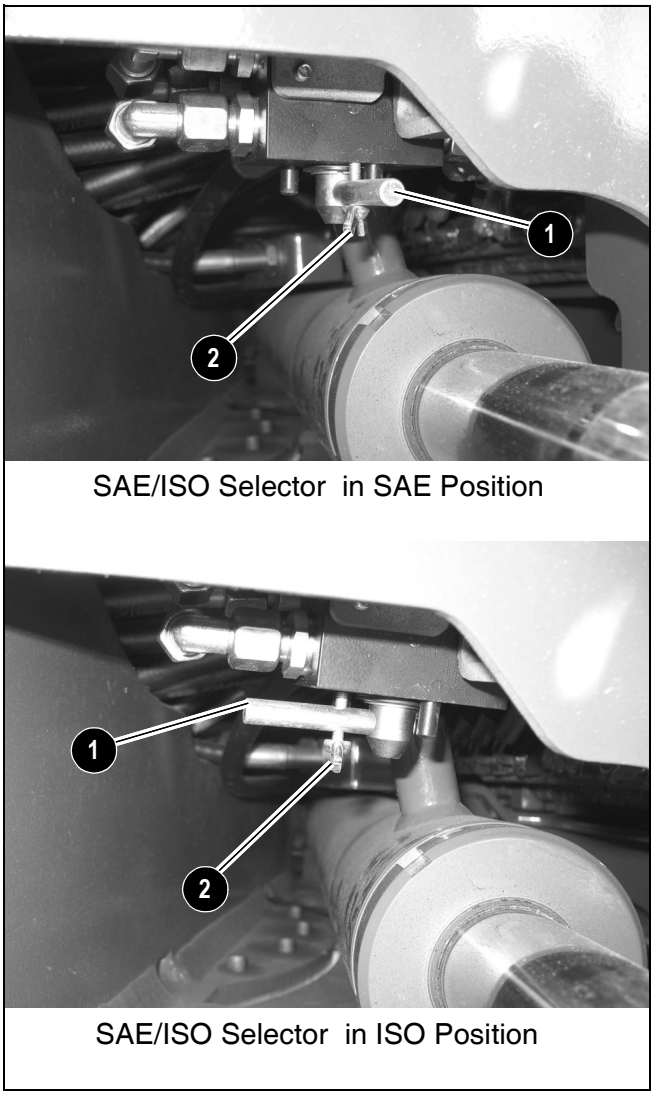


Figure 3-14 SAE/ISO Selector

Throttle Lever

The engine speed is controlled by the throttle lever (1) located behind the left joystick. See Figure 3-15.

- Push throttle lever (1) forward to decrease engine speed.
- Pull throttle lever (1) rearward to increase engine speed.

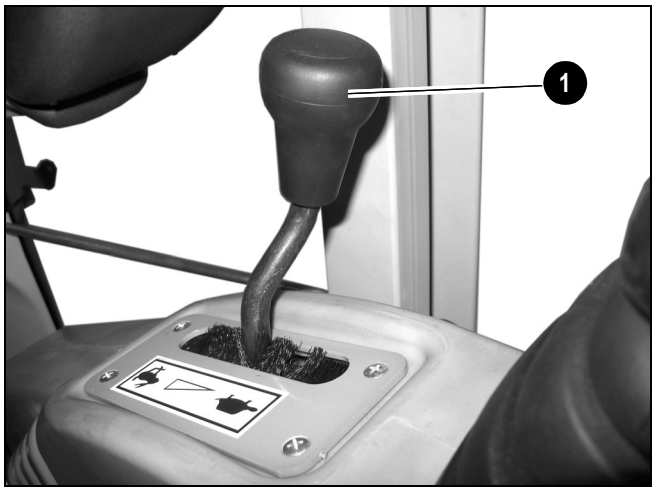


Figure 3-15 Throttle Lever

Optional Auto-Idle Feature

Serial Numbers AG00573 and Up

Press switch (1) to enable the auto-idle feature. When the auto-idle feature is enabled, engine speed is automatically lowered to idle when no hydraulic functions occur for five seconds. Engine speed resumes when a hydraulic function is activated.

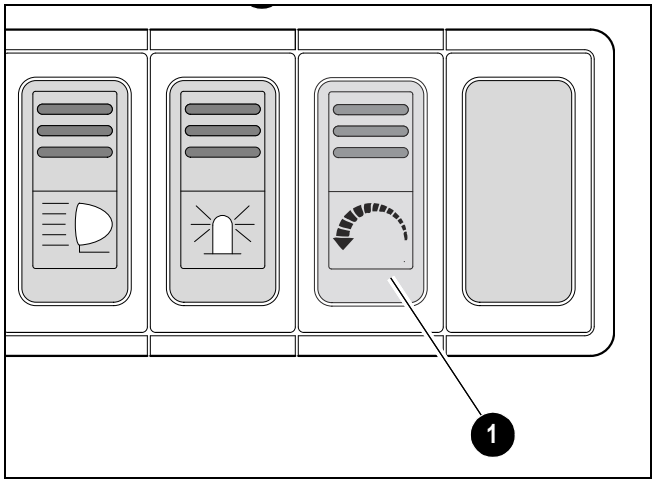


Figure 3-16 Auto-idle switch

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Boom Swivel Pedal

The boom can be swiveled without moving the swing frame by pressing and holding the auxiliary hydraulic/changeover button (1, Figure 3-17) on top of the left hand joystick, and then pressing the boom swivel pedal (2) forward or rearward. Pressing and holding the auxiliary hydraulic/changeover button (1) and pressing the front of the auxiliary hydraulics pedal (2) swivels the boom to the left. Pressing and holding the auxiliary hydraulic/changeover button (1) and pressing the back of the auxiliary hydraulics pedal (2) swivels the boom to the right.

When the auxiliary hydraulic/changeover button is pressed and boom swivel is enabled, indicator (3) is lit.

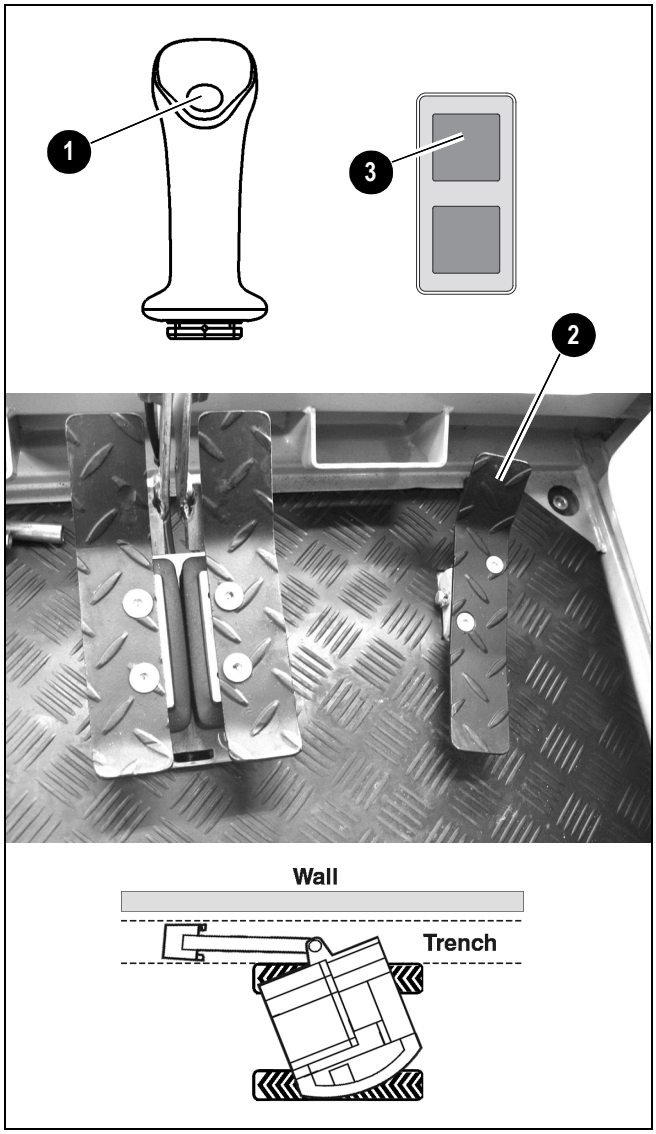


Figure 3-17 Boom Swivel

Dozer Blade

The dozer blade is controlled by the dozer control lever (1) located next to the right joystick. See Figure 3-18.

- Push lever forward to lower the blade.
- Pull lever rearward to raise the blade.



Figure 3-18 Dozer Blade Controls

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Operator's Seat Adjustments

Note: *The operator's seat left console must be raised in order to exit the cab. In the lowered or work position, all operational functions are activated, and operator exit is blocked by the warning arm/lever. In the raised position, the all hydraulic functions of the machine are locked out.*

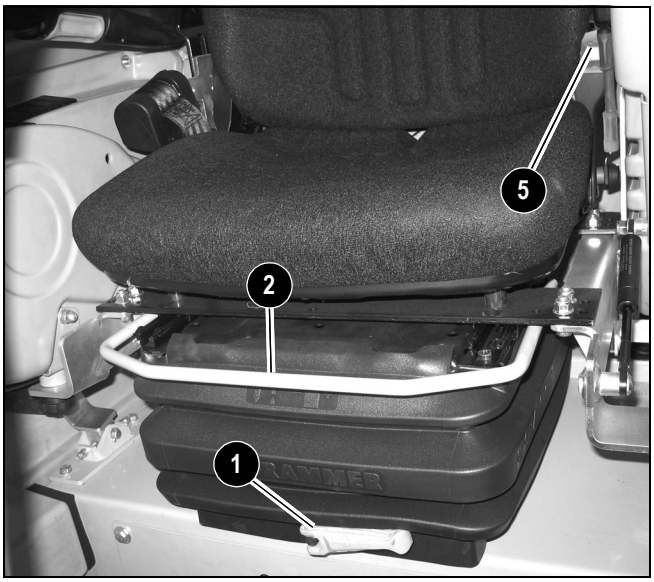


Figure 3-19 Seat Adjustment – Cab Shown

1. Seat Suspension Adjustment

Rotate the knob / lever (1) to adjust the seat suspension for the operator's weight. An indicator on the front of the seat base shows the weight adjustment in kilograms. (1 kg = 2.2 lbs.) Adjust the seat suspension correctly to ensure a comfortable ride. See Figure 3-19.

2. Horizontal Seat and Control Adjustment

The seat adjustment lever (2) allows the operator to move both the seat and the controls forward and rearward.

3. Armrest Adjustments

Angle Adjustment

Use the armrest angle adjustment spindle (1, Figure 3-20) to change the angle of the armrest.

Height Adjustment

Use the armrest height adjustment (2) to raise/lower the armrest as a unit.

Note: *The rear of the left armrest has a turnbuckle that may need to be adjusted to allow the left armrest to rotate out of the way when the left console is raised. Use the turnbuckle to adjust the armrest so it does not contact the left control lever when raising the left console to the lock-out position.*

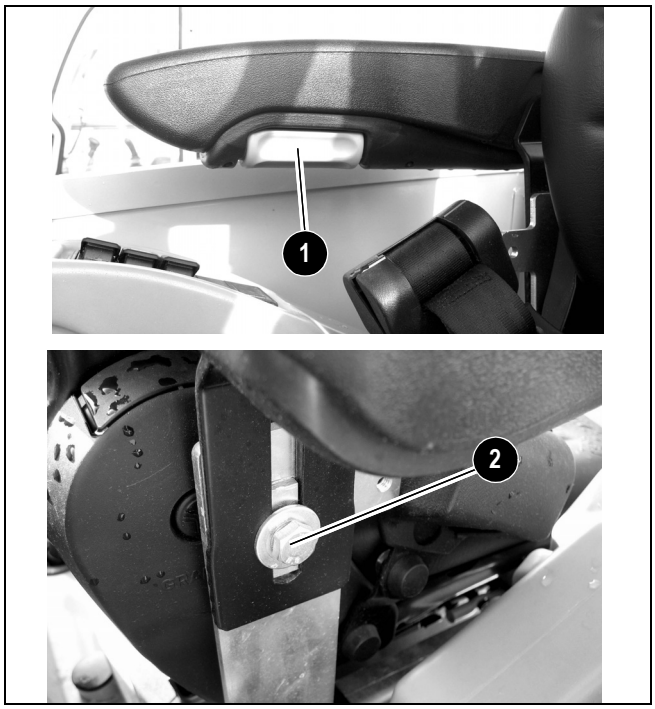


Figure 3-20 Armrest Adjustments

4. Backrest Adjustment

The backrest adjustment lever (4) allows the operator to move the backrest forward and rearward.

5. Headrest Adjustment

The headrest adjustment (5) allows the operator to move the headrest up and down.

6. Seat Height Adjustment

The seat height adjustment allows the operator to move the seat height up and down. To raise the seat height, grasp the seat and lift up until you hear an audible click. To lower the seat, raise the seat to the highest position and then lower the seat to its lowest position.

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Seat Belt

WARNING

ALWAYS fasten the seat belt securely and properly. Never operate the machine without the seat belt fastened around the operator.

Keep the seat belt clean because dirt can impair seat belt operation. Check seat belt condition regularly and have damaged or worn belts immediately repaired by an authorized workshop.

After an accident the seat belt strap is stretched and must be replaced with a new strap installed by an authorized workshop.

Make sure the seat belt is not twisted when it is fastened, and that it is fastened over the hips and not the stomach.

Fasten the seat belt tightly and securely. Remove hard, edged or fragile objects from your pockets or clothes that might lie between the seatbelt and your body.

Fastening/Unfastening the Seat Belt

Fasten the seat belt around your hips and waist and insert tab (A, Figure 3-21) into buckle (B) until it clicks securely in place. Slack in the seat belt should automatically retract into seat belt spool (D).

Unfasten the seat belt by pressing button (C).

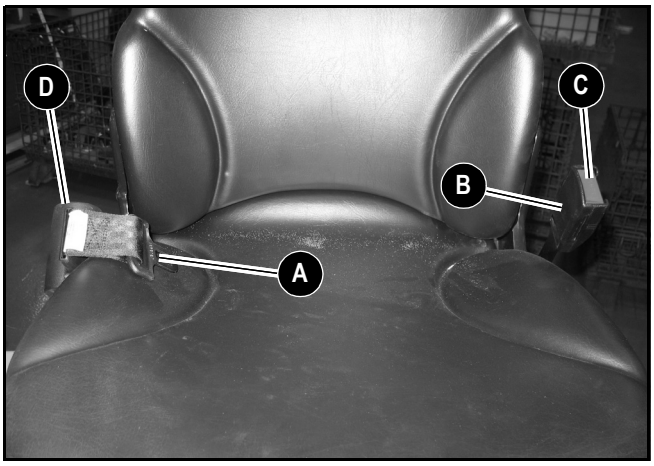


Figure 3-21 Seat Belt

Ventilation – Cab Only

Windshield

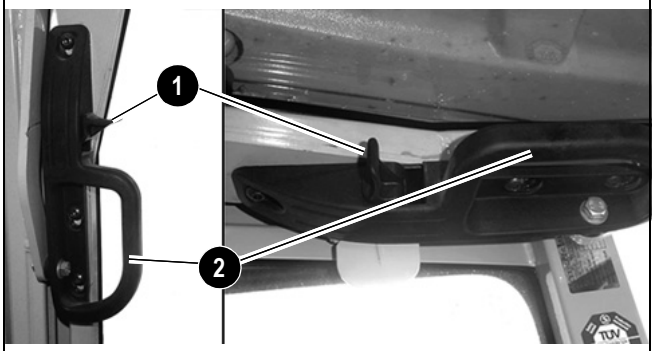
WARNING

When opening the windshield, be sure to lock both latches. When closing the windshield, keep hands on the handles and away from the path of the window.

Opening the Windshield

The windshield can be opened for ventilation. Squeeze/turn the latches (1, Figure 3-22) located at the upper corners of the windshield. Grasp the handles (2) and pull the windshield up until the latches lock in the open position.

Serial Numbers AE02348 and up



Serial Numbers AE02347 and before

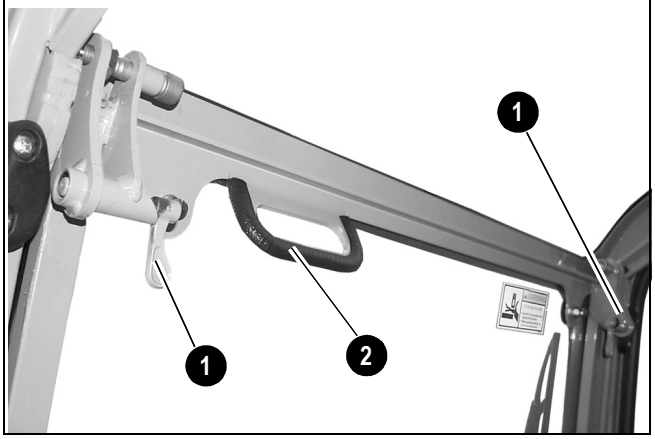


Figure 3-22 Windshield Latches

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CAUTION

Support the windshield when releasing it from the ceiling catches to avoid possible head injury.

To close the windshield, re-install the lower windshield (if removed), and squeeze/turn the latches, and then lower the windshield and lock the latches in the closed position.

Cab Door Latch Release

When fully opened, the left cab door will latch in position to the side of the cab. To release the latch, use the knob (1) located on the inside of the door frame. See Figure 3-23.

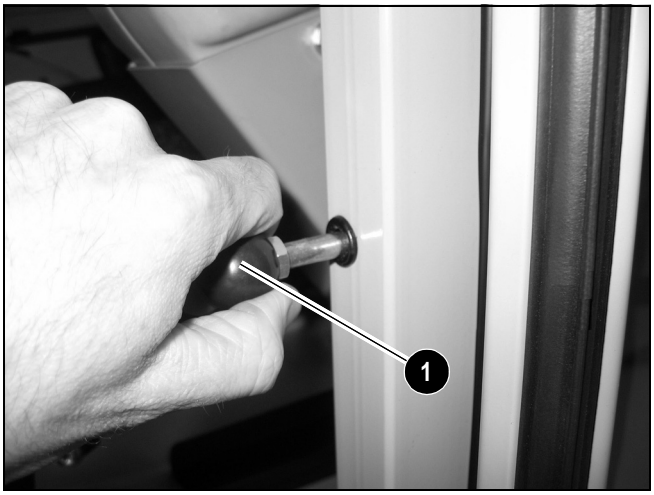


Figure 3-23 Cab Door Latch Release

Interior Light

The interior light is located on the back of the cab above the rear window. Press the switch to the right or left to turn the light ON. Move the switch to the center position to turn the light OFF.



Figure 3-24 Interior Light

Cab Heat Control (cab only)

During the colder months, the operator's cab heater can be operated using the heater control (1, Figure 3-25) on the right of the kick plate below the operator's seat. Rotate the control clockwise to reduce the heat; counter-clockwise to increase the heat.

Recirculated Air Mode (cab only)

When heating or cooling the cab, the recirculated air mode heats or cools using only air from inside the cab and not air from outside the cab. Sliding the plate to the left will turn OFF the recirculated air mode by closing the vent (Figure 3-25). Sliding the plate to the right will turn ON the recirculated air mode by opening the vent.

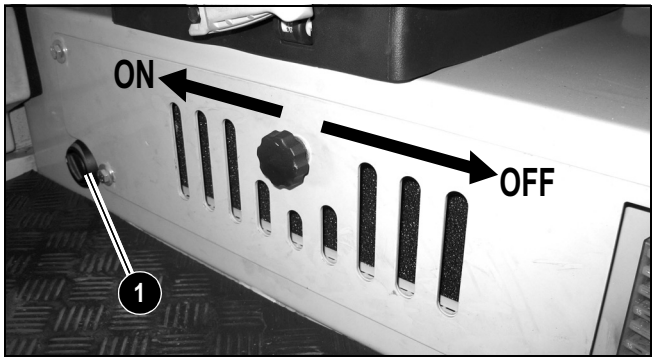


Figure 3-25 Recirculated Air Mode/Heater Control

Tool Kit and Cab Jack Handle

The machine tool kit and the cab jack handle are located in the storage area under the hood in the engine compartment.

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MACHINE OPERATION

⚠ WARNING

- **Read and understand this entire manual. Follow warnings and instructions for operation and maintenance. Failure to follow instructions can result in injury or death.**
- **Read and understand all safety decals before operating the machine. DO NOT operate the machine unless all factory installed guards and shields are in place.**
- **Be sure you are familiar with all safety devices and controls before operating the machine.**
- **Know how to stop the machine before starting.**
- **Use only with approved accessories or referral attachments. Manitou Americas, Inc. cannot be responsible for safety if the unit is used with non-approved attachments.**
- **Check for correct function after adjustments or maintenance.**

Pre-Operation Checklist

IMPORTANT

See the table of recommended lubricants in "Fluid Capacities/Lubricants" on page 1-4 for the proper engine and hydraulic oil specifications. Only use lubricants specified in the table.

Check the following items at the beginning of each work day or every 12 working hours:

- Seat belt and mounting hardware
- Safety decals (replace as required)
- Air cleaner and intake hoses
- Engine coolant level and system for leaks
- Clean engine area of any flammable materials
- Engine oil level (Fill if required)
- Water drained from fuel pre-filter
- Hydraulic system for leaks
- Hydraulic fluid level (Fill if required)
- Pivot points lubricated and operating properly
- Track tension
- Windshield washer reservoir level (if cab installed)
- Broken and/or loose parts (Repair as required)
- Left armrest down in operating position
- Attachment safely locked on machine
- Engine cover closed
- Fuel level

IMPORTANT

Do not completely drain the fuel tank while running the excavator. If this happens, air will enter the fuel system, and the fuel system will have to be bled. Always completely fill the tank with fuel at the end of the working day.

⚠ WARNING

Never use ether starting aids. Glow plugs are used for cold weather starting. The glow plug can cause ether or other starting fluid to detonate, causing injury.

Engine Start and Stop

Note: *When all machine controls are stationary (no pilot control pressure), the swing motor and travel motor brakes are automatically applied. When any control is activated, the appropriate brake is automatically released.*

Note: *All hydraulic functions are locked out when the operator's seat left console is in the raised position.*

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Engine Start Procedure

DANGER

DO NOT run the engine in an enclosed area without proper ventilation. Be sure there is adequate fresh air if running the machine in an enclosed area.

1. Adjust the operator's seat to desired settings.
2. Fasten the seat belt.
3. Be sure all levers and controls are in the neutral positions.
4. Make sure no one is dangerously close to the machine.
5. Insert the ignition key into the switch and turn it clockwise to the (II) position. Indicators for oil pressure and battery voltage will light. In cold weather, the glow plug indicator will come on while the glow plugs warm the engine.
6. Turn the key fully clockwise and hold it until the engine starts, and then release the key.

Note: *The key must be returned to the (I) position between attempts to start the engine in order to activate the glow plug system.*

IMPORTANT

Do not activate the starter motor for longer than 20 seconds during each starting attempt. If the engine does not start, turn the key fully counter-clockwise, wait 30 seconds, and then attempt to start the engine again.

IMPORTANT

Indicator lights must go out when engine starts. If they do not, turn the engine off IMMEDIATELY. Do not use the machine until the problem has been identified and repaired.

7. Allow engine to warm up at idle speed for approximately 10 - 15 minutes to fully warm up all systems.
8. Test the controls.

Cold-weather Engine Starting Procedure

Note: *Install an in-block or tank-style engine heater, which will keep engine block and oil warm for easier cold-weather starting.*

Note: *Be sure the engine oil is correct type and viscosity for the ambient (air) temperature. Refer to "Fluid Capacities/Lubricants" on page 1-4.*

Note: *Be sure the battery is fully charged.*

1. Start the engine according to *"Engine Start Procedure" on page 3-17*.
2. Advance the throttle to 1/4 engine speed for a faster warm up.
3. As the engine warms up, move the throttle lever to the idle position.

After Starting/During Operation

Check the following after startup and during operation. Stop the engine and fix problems before continuing operation.

1. Warning indicator lights on?
2. Travel drive/steering operating properly?
3. Boom, dipper, cab rotation and bucket controls operating properly?
4. Engine exhaust excessively smoky?

Engine Shut-down

Mandatory Safety Shutdown Procedure

Before leaving the machine:

1. Bring the machine to a complete stop on a level surface. Avoid parking on an incline or a hillside, but if this is not possible, park across the slope.
2. Lower the working equipment to the ground and support it securely.
3. Run the engine at idle speed for a few minutes to allow systems to cool after operation at full speed.
4. Turn the key fully counter-clockwise to shut off the engine. Wait for all movement to stop.

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5. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
6. Lock out controls by raising left control console.
7. Remove the ignition key and take it with you. Exit the machine using the hand-holds.

New Machine Break-in Procedure

A new machine requires reduced operational speed during the first 100 operating hours for proper break-in. If the machine is subjected to hard use during the break-in period, damage to the machine may occur.

Perform the following when operating a new machine:

- Perform all steps in "Pre-Operation Checklist" on page 3-16.
- Start engine and let it idle for 10 - 15 minutes so all components and systems can warm up.
- Operate the machine at about 80% of maximum loads and speed.
- At the end of the first 100 operational hours, drain and replace the engine oil and engine oil filter.

Travel

⚠ WARNING

- **Before operating the travel levers, be sure that you know in which direction the machine is pointing. If the dozer blade is not visible from the operator's cab, you are looking at the rear of the machine and the travel controls will be the reverse of normal operation.**
- **Before moving, be sure that there are no personnel in the way of the machine. Sound the horn to alert workers that you are about to move the machine.**
- **Be sure the path is clear during travel.**
- **Use extreme caution when reversing travel. Be sure there is a clear path behind the machine.**
- **Operate the travel control levers smoothly to avoid sudden starts and stops.**

Travel Speed Selection

Two travel speed ranges can be selected by using the travel speed switch (1) located on the control console. See Figure 3-26. The machine uses an "Auto2Speed" transmission on the drive motors. This feature enables the transmission to automatically switch from high-speed to low-speed when it senses a load.

Travel speeds are:

- Slow-Speed Maximum = 1.7 mph (2.8 km/h)
- High-Speed Maximum = 2.9 mph (4.7 km/h)

⚠ CAUTION

The slow-speed setting should be selected to prevent automatic up-shifts if conditions warrant.

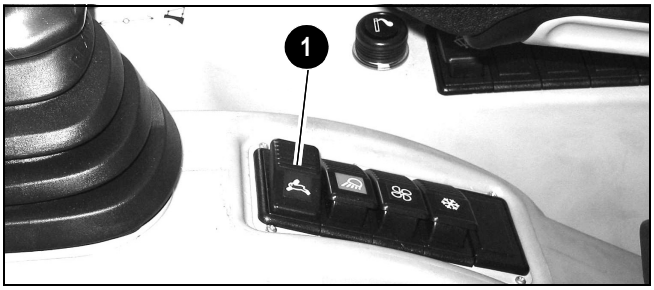


Figure 3-26 Travel Speed Selection

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General Travel Instructions

1. Avoid sudden movements and sharp turns.
2. Travel slowly on rough, frozen, or uneven terrain.
3. Travel straight up and down slopes — never across. See Figure 3-27. Extend arm and lower boom to keep the bucket about 12” (300 mm) off the ground. If the machine starts to slide or becomes unstable, lower the bucket to regain control. If the engine stalls, lower the bucket, make sure that all controls are in the neutral position and restart the engine. See *“Operating on Slopes” on page 3-22* for more information about operating the machine on slopes.

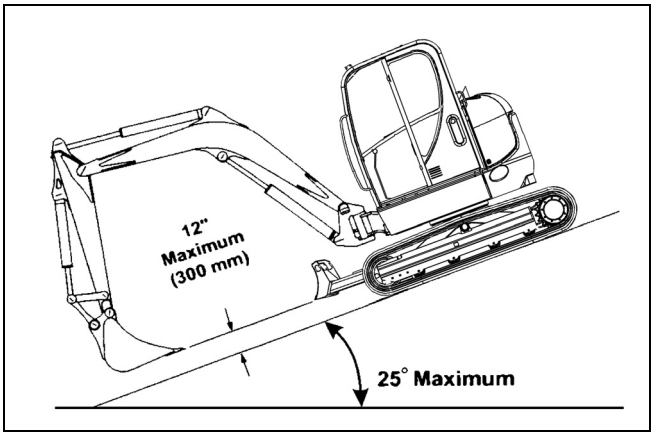


Figure 3-27 Travel Down Slope

4. To travel straight, push both travel control levers (or pedals) forward (or rearward). The farther the levers (or pedals) are moved, the faster the travel speed.
5. Pivot (or wide) turns are made by rotating only one track forward (or rearward). The machine will pivot on the stationary track.
6. Spin turns are made by rotating one track forward and one track rear. The machine will spin around its center.
7. The excavator can travel in water as deep as the top of the upper track rollers. Be sure that the footing is solid so the machine will not sink.

Traveling on Slopes

⚠ WARNING

- **Do not travel up a slope steeper than 15°. Do not travel down a slope steeper than 25°. Keep the boom centered while traveling.**
- **Keep attachments as low as possible when traveling on slopes and or rough terrain.**

Traveling on a slope is hazardous. When traveling, use the following guidelines:

- Travel straight up and down slopes—never across. See Figure 3-28.
- See Figure 3-28 on where to place the dipper arm, boom and bucket for uphill and downhill travel. Raise the bucket 10” – 12" (20 cm – 30 cm) off the ground for better stability. If the machine starts to slide or becomes unstable, lower the bucket to regain control. If the engine stalls, lower the bucket, be sure that all controls are in the neutral position and restart the engine.
- When traveling down a slope, control the speed with the travel levers and the throttle control; reduce engine speed.
- To achieve the best stability while excavating, lower the dozer blade to the ground.
- Avoid traveling over objects such as rocks, trees, stumps, etc.
- Stop the machine travel before moving the bucket or dozer blade controls.

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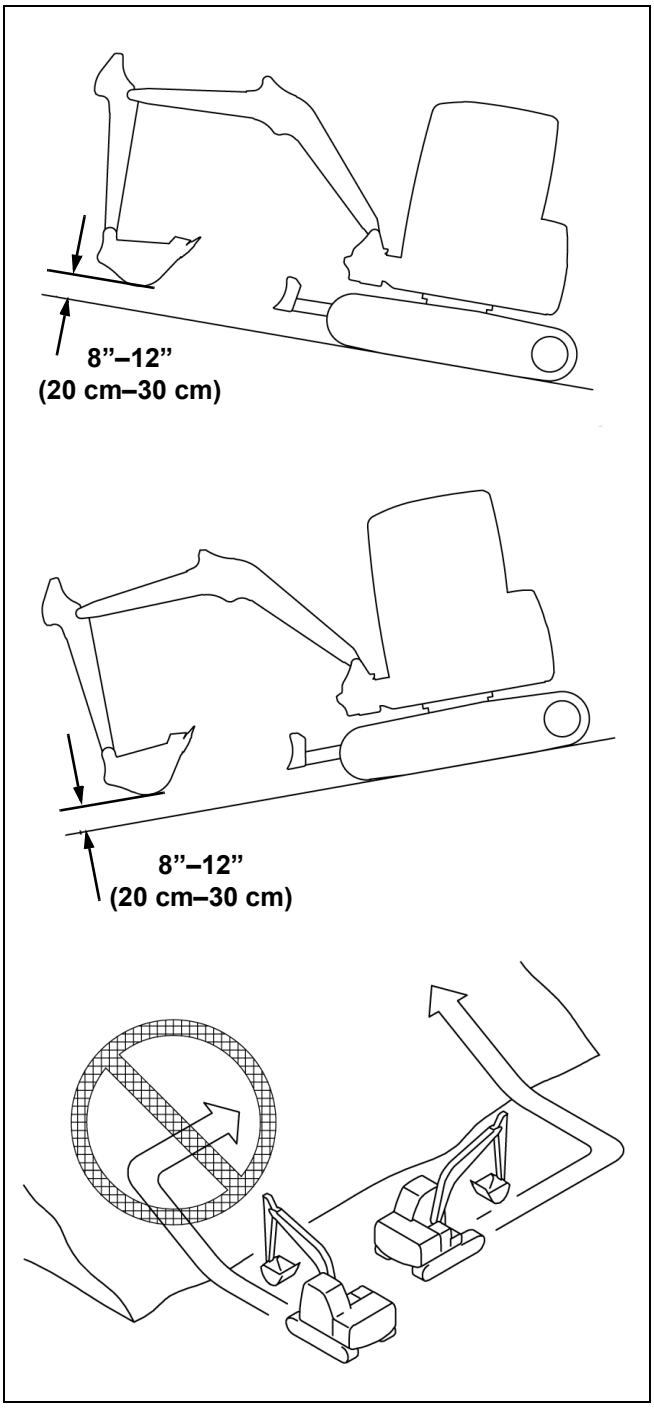


Figure 3-28 Traveling Up or Down Slopes

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Operating Instructions

Joystick Controls

Extending and retracting the cylinders (boom, arm and bucket) are controlled by the joysticks located on the consoles attached to the operator's seat. See *"Equipment and Controls" on page 3-2* for control configurations.

Note: *The joystick controls are pilot-operated. The farther the controls are moved from center, the faster the machine will function.*

Hydraulic Swivel Unit Brake

The upper carriage's rotation is sufficiently braked by moving the control lever back to the initial position. Moving the control lever in the opposite direction brakes the upper carriage with full hydraulic pressure.

IMPORTANT

Hydraulic swivel unit brake function is not optimal if the hydraulic system has not reached operating temperature.

Mechanical Stop Brake

A multi-disc brake integrated into the rotation drive has an additional mechanical brake effect with a time delay. This brake is used to stop the swivel unit from rotating in any position.

Operating Precautions

DANGER

- **DO NOT push down with the dozer blade to elevate the front end of the tracks. This will cause the machine to become unstable.**
- **DO NOT excavate underneath the machine.**
- **Always be sure that there is adequate support when working near trenches or drop-offs. Be aware of conditions that could cause the trench/drop-off wall to collapse, resulting in risk of injury or death.**
- **Do not position the machine directly underneath structures during demolition. Falling objects or structure collapse could cause severe damage or personal injury.**
- **Be sure that there is the proper clearance from overhead electrical lines.**
- **Be sure that all underground electrical power and gas supply lines are clearly marked and avoided.**

WARNING

- **DO NOT rest your feet on the travel pedals during normal machine operation. Unexpected machine movement could occur in this situation.**
- **When working close to an excavated edge, be sure that the ground the machine is sitting on is solid. Keep the travel motors to the rear. See Figure 3-29.**

DO NOT use machine travel or swing to provide additional breakout force when the bucket is in the ground.

DO NOT jam the bucket into the ground and use the weight of the machine to provide additional breakout force.

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When working on soft or muddy ground, be sure that the machine is not sinking.

DO NOT use the bucket as a hammer or ramming device.

IMPORTANT

When digging at maximum excavation depth, BE SURE that the dozer blade does not contact the boom cylinder. Damage to the boom cylinder may occur if it contacts the dozer blade.

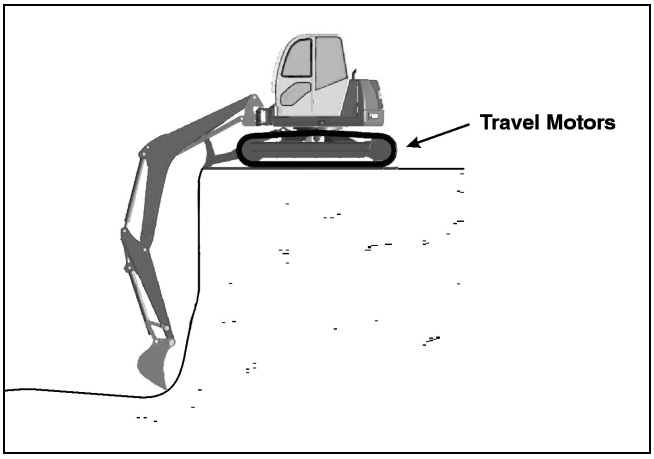


Figure 3-29 Machine Position for Excavating

Operating on Slopes

⚠ WARNING

- **Do not travel up or across a slope steeper than 15°. Do not travel down a slope steeper than 25°. Keep the boom centered while traveling.**
- **Keep attachments as low as possible when traveling on slopes or rough terrain.**

Operating on a slope is hazardous. It is recommended the work area be leveled as shown in Figure 3-30. If this is not possible, use the following guidelines:

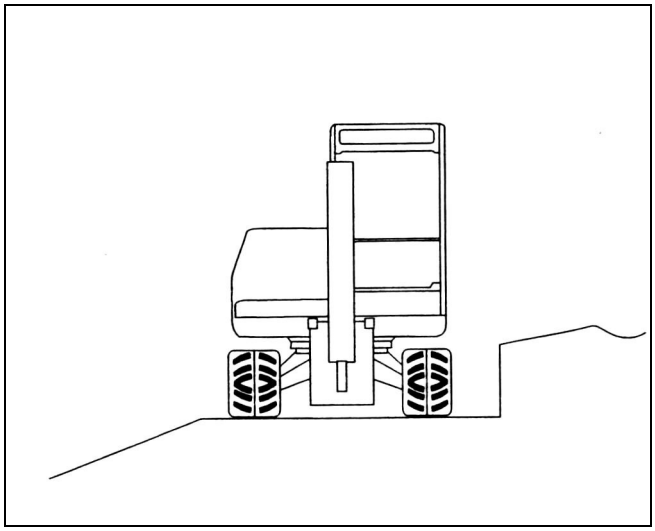


Figure 3-30 Level Work Area on Slope

- Travel straight up and down slopes — never across. See Figure 3-27. Extend arm and lower boom to keep the bucket about 12” (300 mm) off the ground. If the machine starts to slide or becomes unstable, lower the bucket to regain control. If the engine stalls, lower the bucket, be sure that all controls are in the neutral position and restart the engine.
- When traveling down a slope, control the speed with the travel levers and the throttle control.
- When traveling down grades that exceed 15°, put the machine in the position shown in Figure 3-31. Reduce engine speed.

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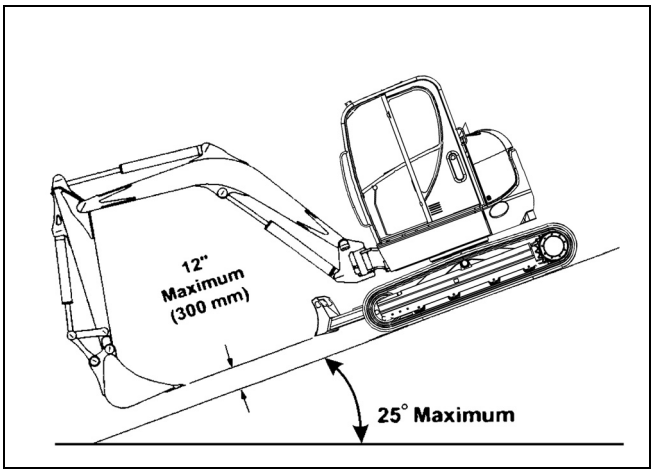


Figure 3-31 Travel Down Slopes

- To achieve the best stability while excavating, lower the dozer blade to the ground.
- Operate as slowly as possible and avoid sudden changes in direction.
- Avoid traveling over objects such as rocks, trees, stumps, etc.
- Stop the machine travel before moving the bucket or dozer controls.
- Slow the work cycle. Take your time.
- Avoid working with the tracks positioned across the slope. Position the machine with the blade downhill and lowered.
- Avoid swinging or extending the bucket farther than necessary in a downhill direction. If you must swing the bucket downhill, keep the boom low and skid the bucket along the ground.
- When working with the bucket on the uphill side, keep the bucket as close to the ground as possible. Unload far enough away from the excavation to prevent the possibility of a cave-in.

Operating in Cold Weather

In cold weather, mud should be removed from the machine before parking. If possible, park the machine on solid ground, or wood planks, to prevent the track or undercarriage from freezing to the ground.

Operating in Water

Do not operate or immerse the machine in water higher than the top of the upper track rollers.

Thoroughly grease the machine if it has been operated in deep water.

Operating Auxiliary Hydraulics

Use the auxiliary hydraulics pedal (1, Figure 3-32) to regulate oil flow through auxiliary attachments. Press the pedal forward (F) for oil to flow into the auxiliary attachments and rearward (R) for oil to flow out.

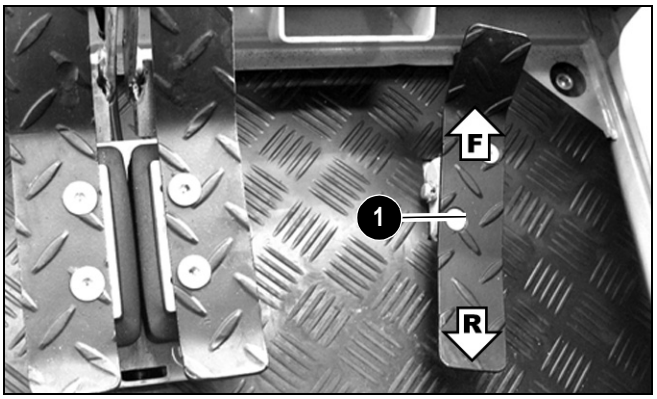


Figure 3-32 Auxiliary Hydraulics Control

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Swiveling the Boom

⚠ WARNING

Working with the boom swiveled to the side reduces lifting capacity.

Overloading the bucket can cause an unstable condition and increase the possibility of tipping the machine.

The excavator boom can be swiveled from the front position 55º to the right and 75º to the left. This allows excavation of trenches along walls, fences, etc. See Figure 3-33.

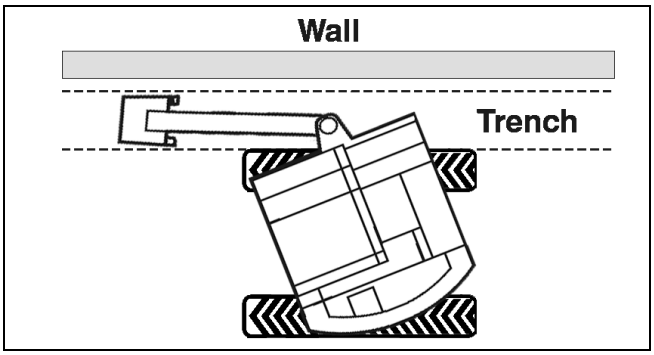


Figure 3-33 Boom Swiveled

Press and hold the auxiliary control button (1, Figure 3-34), located on top of the left joystick. Then press the auxiliary hydraulics pedal (2) with your toe or heel. Pressing and holding the auxiliary hydraulic/changeover button (1) and pressing the front of the auxiliary hydraulics pedal (2) swiveled the boom to the left. Pressing and holding the auxiliary hydraulic/changeover button (1) and pressing the back of the auxiliary hydraulics pedal (2) swivels the boom to the right.

Note: *Bucket controls do not change when swiveling the boom.*

When the auxiliary hydraulic/changeover button is pressed and boom swivel is enabled, indicator (3) is lit.

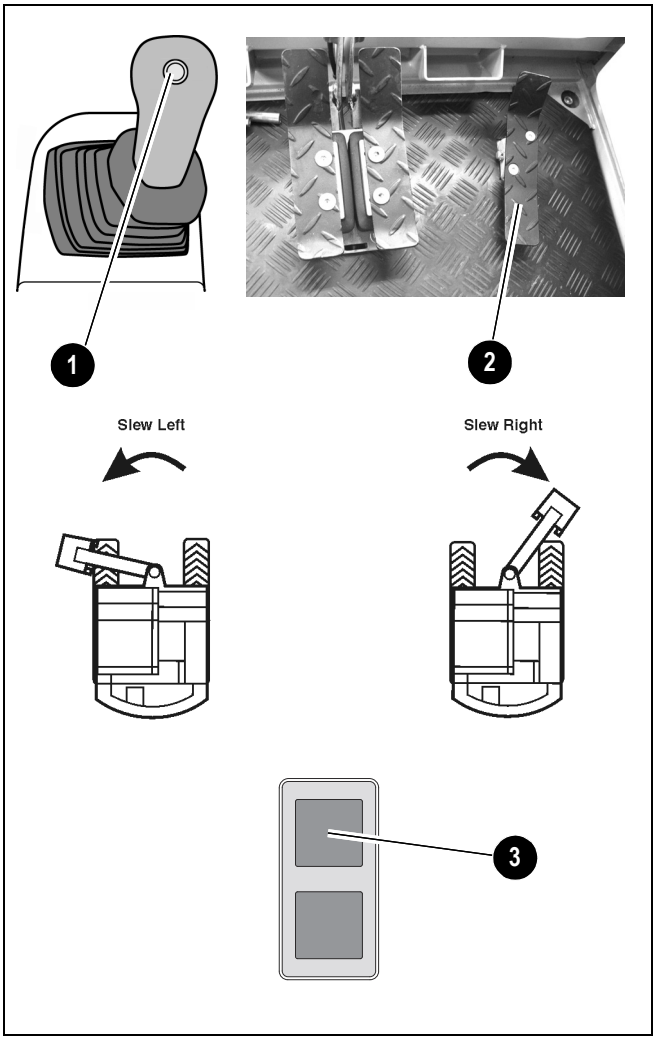


Figure 3-34 Boom Swivel Control

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Excavating

The following section applies to an excavator with a standard bucket, which is used mainly for digging into the ground to loosen, excavate and load loose or solid material.

IMPORTANT

Never use the excavator bucket to perform actions other than digging, grading, loading and excavating. Damage to the excavator could result.

- **Do not use the swiveling force of the excavator so the bucket serves as a hammer or battering ram (1, Figure 3-35).**
- **Do not lower the bucket into the ground while rotating the upper carriage or driving the excavator (2, Figure 3-36).**
- **Do not use the falling force of the dipper arm so the bucket serves as a hammer or pile-driver (3).**
- **Do not cause the excavator to tip, bounce or fall to amplify digging or excavating (4) force.**

- Use caution when retracting the bucket to prepare for driving or transport. Hitting the bucket into the dozer blade might damage either attachment, especially the bucket teeth.
- The dozer blade is intended for grading only; using it as a battering ram risks serious damage to the blade, its cylinder and connections.

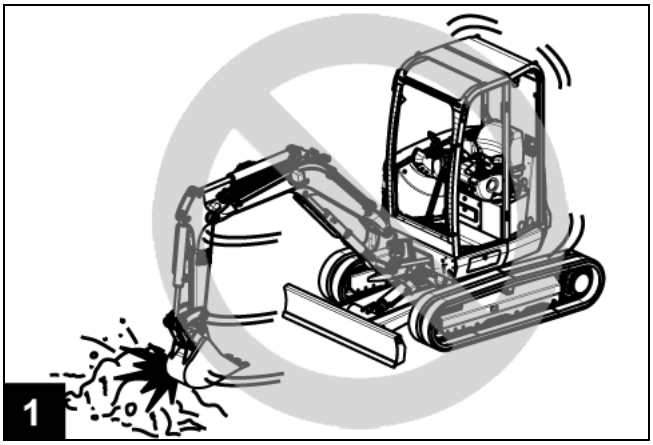


Figure 3-35 Machine Operation Exclusions

- When excavating, lower the dozer blade to the ground to aid machine stability. It is best to position the dozer blade on the same side as the excavation, but position the blade on the opposite side of the excavation if the situation prevents the former.

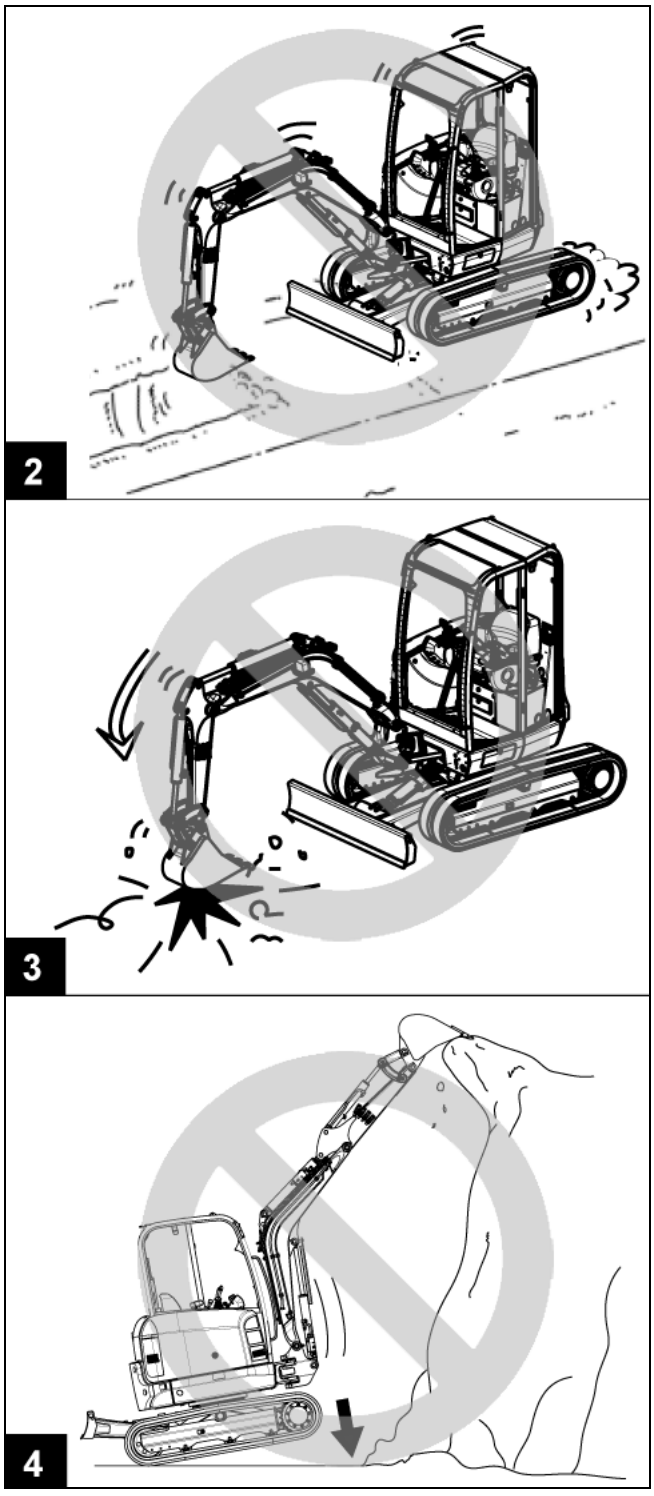


Figure 3-36 Machine Operation Exclusions

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Digging

Proper Bucket Position

Move the flat side of the bucket so it is parallel to the ground (Figure 3-37).

IMPORTANT

Positions 2 and 3 in Figure 3-37 show improper positions for using the bucket. Position 2 forces the bucket downward into the ground, slowing down work and subjecting the engine and hydraulic pump to overloading.
Position 3 forces the bucket upward toward the ground surface, reducing productivity because of smaller loads being dug.

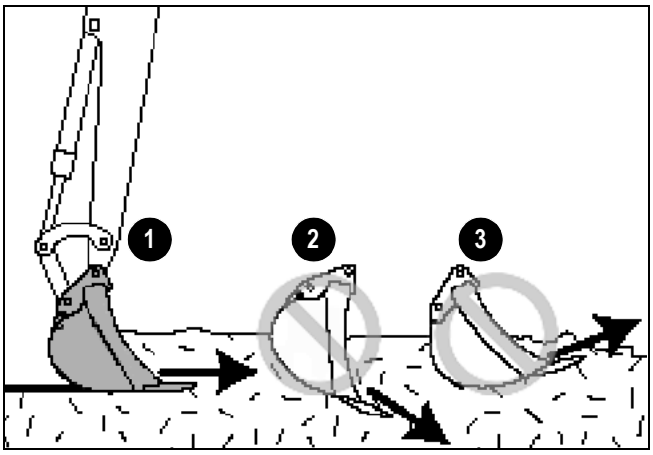


Figure 3-37 Proper Bucket Position

Proper Digging Technique

1. Lower the bucket into the ground (4, Figure 3-38).
2. After the bucket penetrates the ground, adjust it so its flat side is parallel to the ground (5, Figure 3-38).
3. Pull the bucket towards the excavator by:
   a. Moving the dipper arm toward the excavator, and
   b. Lowering the boom.
4. After the bucket is sufficiently filled:
   a. Continue moving the dipper arm toward the excavator,
   b. Extend the dipper arm cylinder so the bucket is tilted upward (6, Figure 3-38).
   c. Raise the boom.

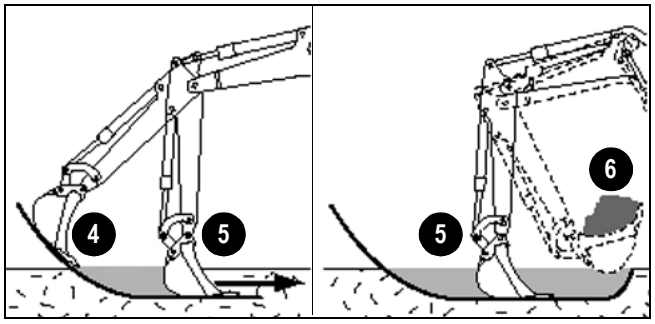


Figure 3-38 Proper Digging Technique

Trench Excavating

Trench excavating is most efficient when the machine tracks are parallel to the line of the trench (Figure 3-39). For larger trenches, excavate each side first and then the center.

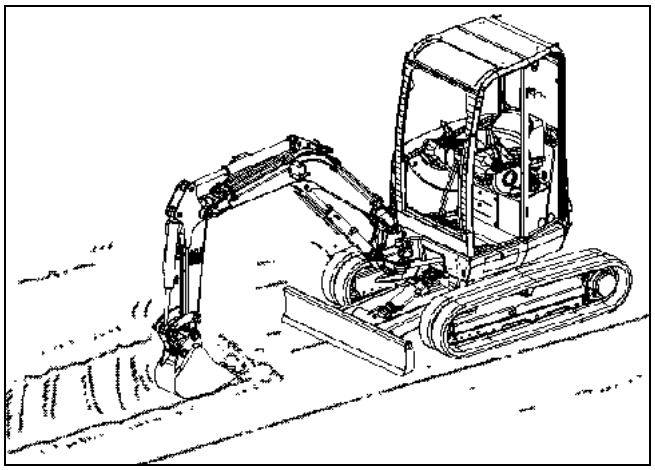


Figure 3-39 Efficient Trench Excavating

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When trench excavating is needed in confined areas, the excavating can be done by rotating the upper carriage and swiveling the boom (Figure 3-40).

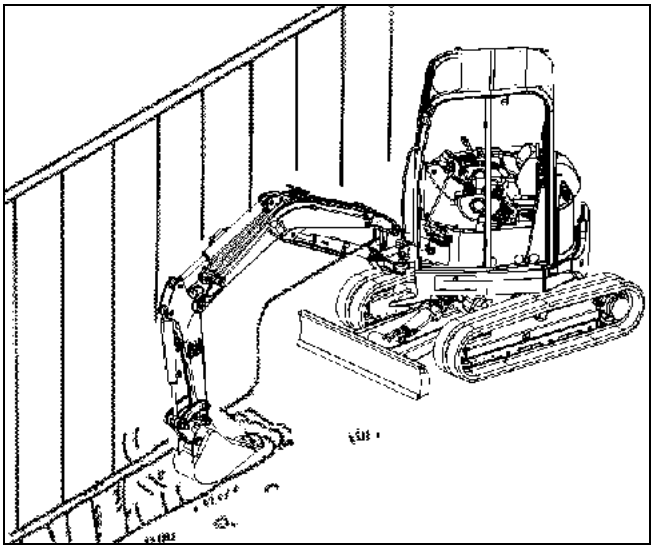


Figure 3-40 Excavating Trenches Sideways

- Working alongside trenches and deep excavation are two applications where the dozer blade might restrict bucket movement. When working alongside trenches, lower and place the dozer blade on the ground to avoid damage to the boom cylinder. When deep excavating, position the machine so the lowered dozer blade is on the opposite side of the excavation (Figure 3-41).

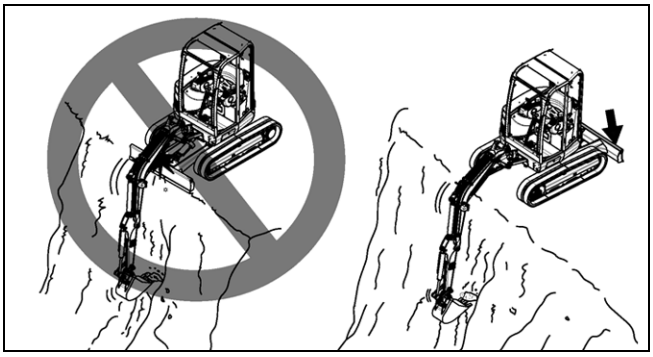


Figure 3-41 Dozer Blade Positioning

⚠ WARNING

Placing the dozer blade on the opposite side of the excavation decreases machine stability. Always consider operator safety when operating the machine, especially when less-than-ideal working conditions.

Loading Vehicles

When loading vehicles, consider the following:

- Whenever loading in a confined area with a limited range of motion, position the truck so maximum visibility is ensured for the excavator operator.
- When work conditions permit, position the truck so the excavator can load material at the rear of the truck instead of the sides (1, Figure 3-42). The most effective way to load into the rear of the truck is when the truck and excavator form a 45° angle (2, Figure 3-42).
- Raise the boom and dipper arm to dump height just before rotating toward the truck.
- Whenever possible, dump upwind to keep dust and airborne debris away from the operator, and the excavator air filters and fans.

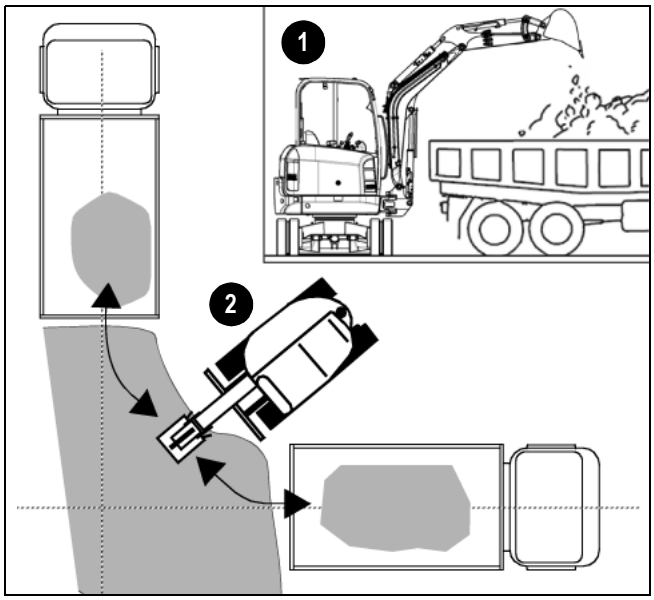


Figure 3-42 Loading Vehicles

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Grading

Bulldozing

WARNING

- **Be sure there is proper clearance for the front end attachments when bulldozing.**
- **Be sure that the front end attachments do not contact overhead power lines or obstructions during bulldozing.**
- **DO NOT drive the machine into the excavation or onto loose soil, which can cause an unstable condition, and could possibly tip the machine.**

1. Raise or lower the dozer blade using the control lever located to the right of the travel levers/pedals. See Figure 3-43. Move the lever forward to lower the dozer blade, rearward to raise the dozer blade.
2. The boom must be fully raised and the bucket curled in (up) when grading.
3. When grading, the material may be pushed away to the front or the side.
4. Raise the dozer blade slightly if excessive resistance occurs.
5. When the blade is in position, use the travel controls to move the machine as in normal travel.



Figure 3-43 Dozer Blade Control

Mounting/Removing Buckets

ALWAYS wear protective goggles, helmets, gloves, steel-toed shoes, etc.

DO NOT service the bucket while the engine is running.

DO NOT stand behind the bucket when removing the pins.

DO NOT use your hands or fingers to align the bucket and dipper arm holes.

ALWAYS verify the bucket is safely locked before starting the engine and resuming operation.

WARNING

- **DO NOT use a hammer directly on a securing pin to loosen it. The pounding may cause splintering, which may lead to serious injury.**
- **The bucket can crush hands or feet. DO NOT use your hands or feet as substitutes for the correct equipment.**

Removing A Bucket

1. Lower the bucket to the ground with the flat side facing down (1, Figure 3-44).

IMPORTANT

Place the bucket against the ground with minimum pressure. More pressure increases resistance, which will make it more difficult to remove the pins.

2. Stop the engine.
3. Remove the two lynch pins (2A and 2B, Figure 3-44).

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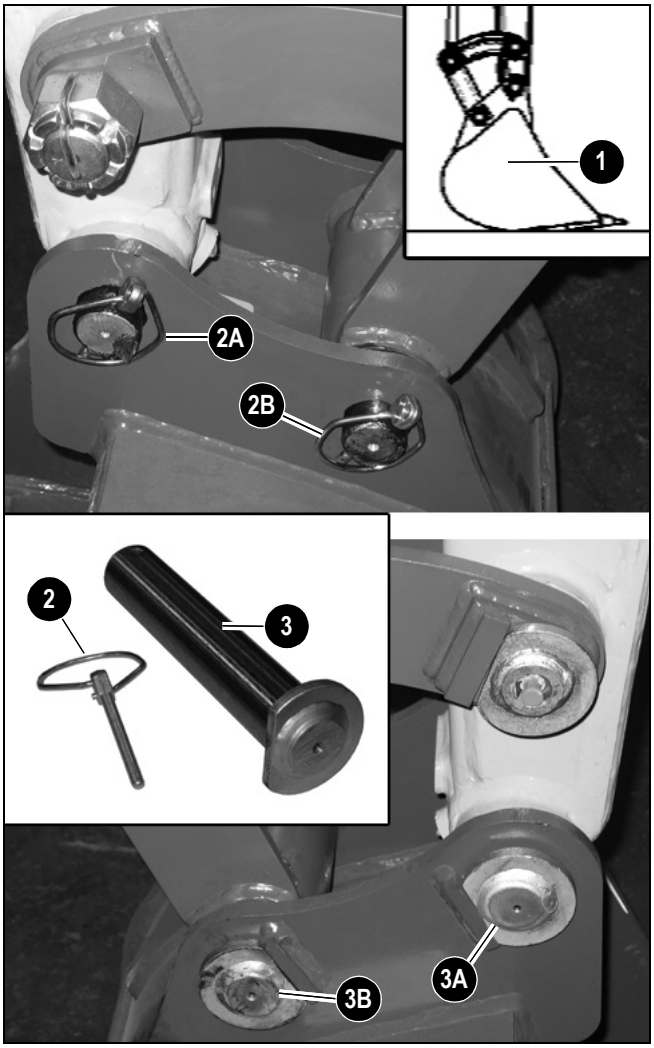


Figure 3-44 Bucket Removal/Mounting

4. Remove the lower securing pin first (3B, Figure 3-44) and then the other (3A). Carefully remove the pins with a hammer and brass punch if they are stuck. Once pin 3B is removed, pin 3A might have more pressure applied against it, making it difficult to remove. If this happens:
   a. Start the engine.
   b. Slightly raise and lower the boom to relieve pressure from the pin.
   c. Turn off the engine.
   d. Try removing the pin again, using a hammer and brass punch if needed.

Attaching A Bucket

1. Grease the dipper arm and bucket holes.
2. Since the bucket is on the ground and stationary, maneuver the machine until the dipper arm holes align flush with the bucket holes.

⚠ WARNING

DO NOT use your hands or fingers to align the bucket and dipper arm holes.

3. Stop the engine.
4. Insert the upper securing pin first (3A, Figure 3-44). If needed, use a hammer and brass punch to gently tap the pin through the hole. Insert a lynch pin (2A, Figure 3-44) through the hole in the pin and lock.

IMPORTANT

The flat side of each securing pin head must align with the flat guide on each side of the hole; see 3A and 3B in Figure 3-27 for how the pins look when properly installed.

5. Insert the lower securing pin (3B, Figure 3-44). If needed, use a hammer and brass punch to gently tap the pin through the hole. Insert a lynch pin (2B, Figure 3-44) through the hole in the pin. Lock the lynch pin securely in place.
6. Verify the bucket is locked and secure before starting the engine and resuming operation.

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Auxiliary Hydraulics Connections

IMPORTANT

Follow the instructions in the operator's manual from the attachment manufacturer for connecting the attachment to the machine's auxiliary hydraulics.

Figure 3-45 shows the three quick connections on the dipper arm meant for auxiliary hydraulics, which are for the following:

- **1:** Pressure line (male connector)
- **2:** Large return line (female connector)
- **3:** Pressure line (female connector)

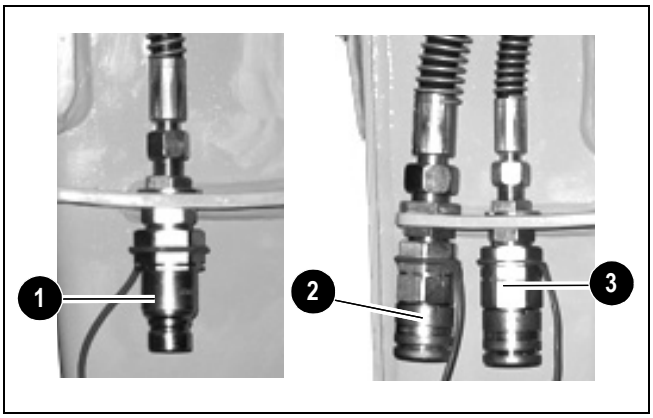


Figure 3-45 Auxiliary Hydraulics Connections

Connecting the Quick Couplings

1. Park the machine on firm and level ground.
2. Extend the dipper arm cylinder halfway and position the boom/dipper arm so the auxiliary hydraulic connectors are positioned as shown in Figure 3-45.
3. Stop the engine.
4. Turn the ignition key to position 1.
5. Release pressure from the bucket cylinder by moving the left control lever to the left and right.
6. Lift the left control lever base as a safety precaution.
7. To connect each coupling:
   a. If necessary, rotate lock sleeve (2, Figure 3-46) so notch (3) aligns with lock ball (4).
   b. Pull lock sleeve (2) down in the direction of arrow (5).
   c. Insert the attachment coupling into the corresponding auxiliary hydraulics connection coupling.
   d. Release lock sleeve (2) so it snaps into place and locks the couplings together. Verify the lock sleeve (2) is snapped closed and the coupling is securely locked together.
   e. Twist lock sleeve (2) so notch (3) is NOT aligned with lock ball (4), to help prevent accidental de-coupling.

Disconnecting the Quick Couplings

1. Perform steps 1 through 6 in "Connecting the Quick Couplings" on page 3-30 before proceeding to the next step.
2. To disconnect each coupling:
   a. Pull lock sleeve (2, Figure 3-46) down in the direction of arrow (5).
   b. Listen for the hissing sound to verify that any pressure has been released from the connection.
   c. Twist lock sleeve (2) so notch (3) is aligned with lock ball (4).
   d. Push lock sleeve (2) up in the direction of arrow (6) to disconnect the coupling.

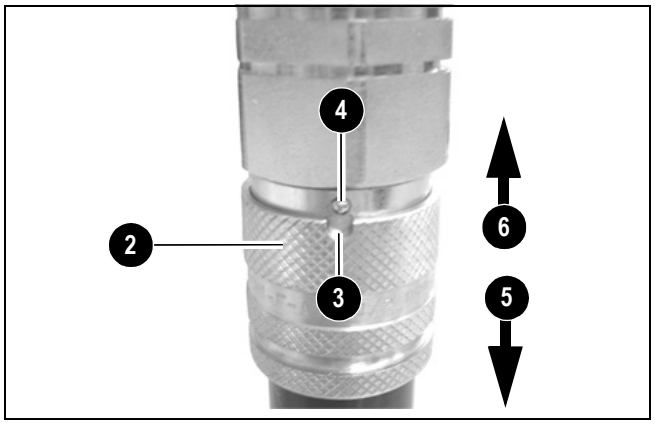


Figure 3-46 Quick Coupling Connections

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Transporting

Towing

WARNING

- **When towing the machine, make sure no one is close to the towing apparatus, or in between the vehicles. The machine may only be towed using suitable towing equipment, in connection with suitable towing apparatus, such as a towing coupling, hooks and eyes.**
- **Do not use a towing apparatus that is kinked, twisted, or otherwise damaged.**
- **Do not apply high loads abruptly to the retrieval apparatus. The towing bracket has a maximum admissible load of 5238 lbf (2330 daN).**
- **The towing bracket is designed for retrieving the machine only. Do not use the excavator to tow other vehicles.**
- **Do not tow the machine if the travel drive is damaged. Damage to the machine cause by towing is not covered under warranty.**

The excavator can be towed by using the towing bracket (1, Figure 3-47). Secure a towing shackle, shackle pin and lock (2) of adequate size to the towing bracket (1) as shown. Tow the machine slowly and only short distances.

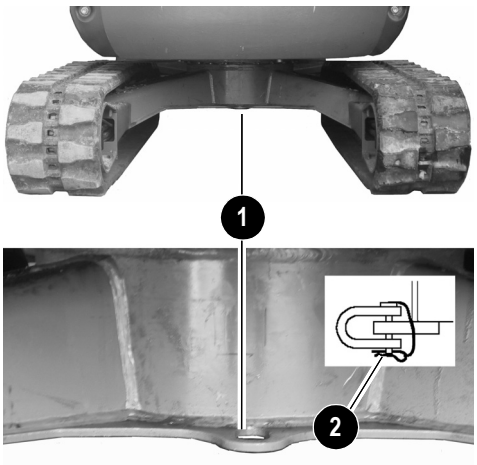


Figure 3-47 Towing

Lifting the Machine

WARNING

- **Use a lifting device and rigging with sufficient capacity for the weight of the machine plus any attachments.**
- **Maintain center-of-gravity and balance points on the machine. See Figure 3-48.**
- **Do not swing boom.**
- **Never lift machine with the operator aboard.**

Secure the lifting fixture sling to the lifting points (1, Figure 3-48) on the machine as follows:

- length L1 on the lifting sling for the boom must be 6’3” (1.9 m) long.
- Length L2 on the lifting sling must be 10’4” (3.15 m) long.

Do not exceed rated load capacity of the lifting machine. See *“General Specifications” on page 1-9* for excavator weight.

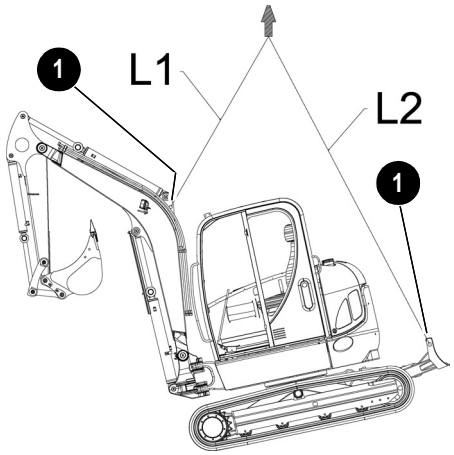


Figure 3-48 Machine Lifting Points

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Loading and Transporting

Note: *Refer to Figure 3-49.*

Use only transporters that are in proper working order and are approved for use on public roads.

When using ramps to load the transporter:

- Do not exceed an incline of 17°.
- Clean dirt, mud, ice and snow from the ramps and tracks.
- Use metal loading ramps with a slip-resistant surface, and with beveled ends to prevent damage to rubber tracks.

Loading Procedure:

1. Attach ramps securely to the transporter to prevent them from slipping off during loading.
2. Load the transporter on solid, even ground.
3. Engage the transporter parking brake and chock the wheels.
4. Determine the direction of the track movement (blade facing forward) before moving the excavator onto the ramps.
5. After the excavator is on the transporter, lower the dozer blade and the bucket onto the loading surface and turn off the excavator engine.
6. Lock the cab.
7. Place chocks under the excavator tracks.
8. Secure the excavator to the transporter at the tie-down points (1, Figure 3-49) to prevent the excavator from slipping, overturning or moving during transport.

Note: *The tie-down points on the excavator are identified by decals (1, Figure 3-49).*

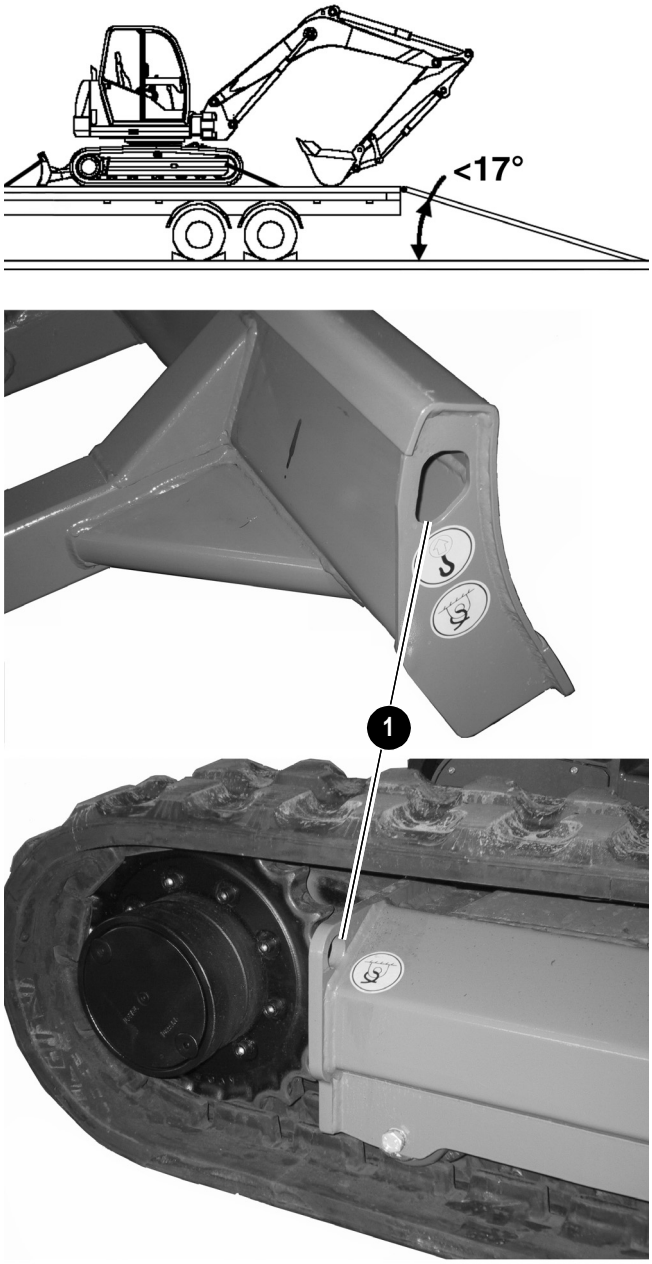


Figure 3-49 Loading and Transporting

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CHAPTER 4 – MAINTENANCE

GENERAL INFORMATION CARE AND SERVICING

⚠ WARNING

Read and understand this entire manual before operating and/or servicing the machine. Follow warnings and instructions for operation and maintenance. Check for correct function after adjustments or maintenance. Failure to follow instructions can result in injury or death.

⚠ WARNING

Be sure you are familiar with all safety devices and controls before operating or servicing the machine. Know how to stop before starting. The machine is designed for use only with approved accessories or referral attachments. Manitou Americas, Inc. cannot be responsible for safety if the machine is used with non-approved attachments.

⚠ WARNING

The hydraulic reservoir is under pressure. Avoid contact with leaking hydraulic fluid and diesel fuel under pressure because they can penetrate the skin and eyes.

Care and Servicing

The care and servicing of the machine has a significant influence on its operational readiness and service life.

Use of lubricants not corresponding to the manufacturer's recommendations may invalidate warranty claims.

More frequent servicing, other than the recommended intervals, may be required under extreme conditions (extremely dusty or hot conditions).

Always dispose of waste lubrication oils and hydraulic fluids according to environmental laws or take to a recycling center for proper disposal. **DO NOT** pour fluids onto the ground or down a drain.

DO NOT power-wash the main hydraulic pumps and controls, throttle solenoids and sealed bearings. High pressure water can be forced through seals and trapped within these components, causing premature failure.

The operating pressure settings of the hydraulic system should only be adjusted by trained, qualified personnel. If malfunctions are caused by unauthorized alteration of operating pressure settings, all warranty responsibilities of the manufacturer are invalidated.

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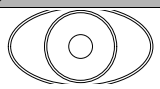
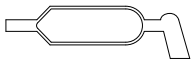
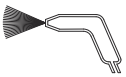
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Maintenance Safety

- Never service the machine without reading the applicable instructions.
- Always lower bucket and dozer blade to the ground before performing any maintenance.
- Use correct procedures to lift and support the machine. Always lift the dozer blade fully before installing jackstands.
- Keep the engine cover and hydraulic valve covers closed except for service. Close and latch covers before operating the machine.
- Be sure to have the work area properly ventilated when grinding or welding parts. Wear a dust mask.
- Exhaust fumes can kill. Exhaust system must be tightly sealed. If working in an enclosed area, vent exhaust to outside if the engine must be run for service.
- Never perform unapproved modifications or add unapproved attachments.
- Stop the engine and let cool, then clean any flammable materials from the engine before checking fluid levels.
- Never service or adjust the machine with the engine running unless it is required by the service procedure.
- Avoid contact with leaking hydraulic fluid and diesel fuel under pressure. The pressurized fluids can penetrate the skin and eyes. NEVER use your hands to search for hydraulic fluid leaks — use a piece of paper or cardboard. Escaping fluid under pressure can be invisible if it penetrates the skin it can cause serious injury. If any fluid is injected into your skin, see a doctor at once. Injected fluid MUST be surgically removed by a doctor familiar with this procedure or gangrene may result.
- Never fill the fuel tank with the engine running, while smoking or when near open flame.
- Wipe up fuel spills immediately.
- Keep your body, jewelry and clothing away from moving parts, electrical contacts, hot parts and exhaust.
- Wear eye protection when servicing the machine.
- Lead-acid batteries produce flammable and explosive gas. Keep arcs, sparks, flames and lighted tobacco away from batteries.
- Batteries contain acid, which burns eyes and skin on contact. Wear protective clothing. If acid contacts body, flush well with water. For eye contact, flush well with water and get immediate medical attention.

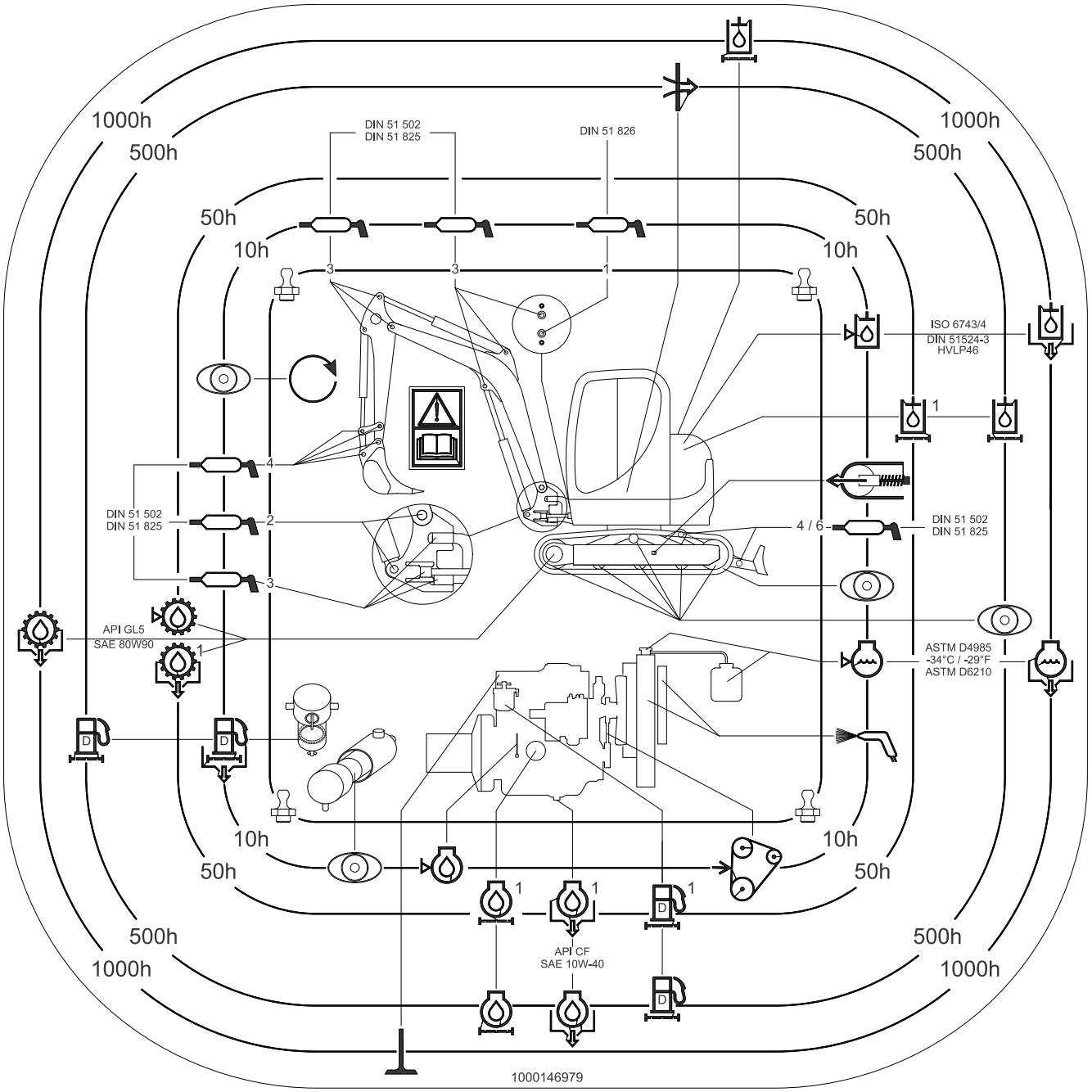
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Maintenance Label Symbols

Symbol	Assembly	Explanation
	General	Visual check
	General	Grease instructions
	Fuel system	Drain condensation from fuel
	Fuel system	Replace the fuel filter; clean the fuel pre-filter
	Radiator	Check the coolant level
	Radiator	Drain and fill with new coolant
	Engine	Check valve clearance; adjust if necessary
	Engine	Check the engine oil level
	Engine	Change engine oil
	Engine	Replace the oil filter
	Engine	Check V-belt tension
	Travel drive	Change oil
	Travel drive	Check the oil
	Undercarriage	Check track tension
	Hydraulic system	Check oil level
	Hydraulic system	Change hydraulic oil
	Hydraulic system	Replace the hydraulic oil filter; replace the breather filter
	Radiator fins	Clean
	Heating, air conditioning	Replace the cab air filter

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Maintenance Label



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MAINTENANCE SCHEDULE

The following service schedule is a recommended. Maintenance work must be done at regular intervals. Failure to perform scheduled maintenance work will result in excessive wear and early machine failures. The following service schedule is a recommended.

Check, Clean and Inspect

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Engine oil level	x					x	
Engine coolant level	x					x	
Hydraulic oil level	x					x	
Check engine/hydraulic oil radiator and air conditioning for contamination; clean if necessary	x					x	
Check cooling system, heating and hoses for leaks and pressure (visual check)	x					x	
Air filter (damage)	x					x	
Inspect water separator pre-filter; drain water	x					x	
Check V-belt condition and tension	x					x	
Check exhaust system for damage	x					x	
Gearbox oil level		x					x
Check battery electrolyte; fill with distilled water if necessary.		x				x	
Replace cab air filter for heating and air conditioning				x			x
Clean water separator				x			x
Empty diesel fuel tank[a]				x			x
Clean battery				x		x	
Check alternator, starter and electrical connections, starter bearing play and function				x			x
Preheating system and electrical connections				x			x
Fuel injection pump, injection and pressure, injection nozzles and valves					x		x
Check injection timing; adjust if necessary					x		x
Check engine valve clearance; set if necessary					x		x
Check pilot control valve filter/restrictor; clean/replace if necessary					x		
Clean drain holes in cab/canopy					x		x

a. After emptying the tank, water must be removed and air must be purged from the fuel system before use. See *"Fuel Shut-off Valve and Water Separator"* on page 4-14 and *"Purging Air from the Fuel System"* on page 4-14.

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Check, Clean & Inspect (continued)

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Check tracks for cracks or cuts	x					x	
Check track tension; adjust if necessary	x					x	
Inspect cylinder piston rods for damage	x					x	
Ensure bucket and attachment pins are secure and locked	x					x	
Pin lock (dipper arm and attachment)	x					x	
Inspect hydraulic line clamps for tightness/damage	x					x	
Clean hydraulic couplings/dirt build-up on the hydraulic system dust caps	x					x	
Grease central lubrication system	x					x	
Inspect engine cover gas strut	x					x	
Check primary pressure relief valve pressure[a]		x		x			x
Check fasteners for tightness[a]		x		x			x
Check indicator lights for correct function[a]		x		x			x
Cab/canopy tilt lock/support components[a]		x		x			x
Insulating mats in the engine compartment		x					x
Warning decals and Operator's Manual in place/undamaged		x					x
Check air filter restriction indicator				x			x
Check bearing play on tread rollers, track carrier rollers and front idlers				x			x

a. Check after first 50 hrs; every 500 hrs thereafter.

Fluid and Filter Changes

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Engine oil		x[a]	x[b]	x			x
Engine oil filter		x[a]		x			x
Fuel filter		x[c]		x			x
Hydraulic oil filter		x[c]		x			x
Gearbox oil		x[d]			x		x
Hydraulic oil				x			x
Breather-hydraulic oil tank					x		x
Air filter element when indicator light comes on					x	x	
Engine coolant					x		x

a. Change after first 50 hrs; every 500 hrs thereafter.
b. Dusty work environment, high temperature, high rate of hammer use, and similar intensive use conditions.
c. Change after first 50 hrs; every 500 hrs thereafter.
d. Change after first 50 hrs; every 1000 hrs thereafter.

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Air Conditioning

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Test air conditioning function		x				x	
Check dehumidifier for corrosion		x					x
Replace cab air filter				x			x
Check refrigerant				x			x
Replace dehumidifier[a]					x		x
Replace compressor oil[a]					x		x

a. Replace every 1000 hrs or once every 2 years, whichever comes first.

Functional Check

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Lights, signaling system, indicators, audible warning system[a]		x					x
Heater function[a]		x					x

a. Operate once weekly

Leakage Check

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Inspect hydraulic lines/hoses for tightness, leaking, or chafing	x					x	
Engine and hydraulic system components	x					x	
Cooling and heating circuit components	x					x	
Traveling drive components	x					x	

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Daily Lubrication

(See Figure 4-1 and Figure 4-2)

Service Activity	Daily	Every 50 Hours	Every 250 Hours	Every 500 Hours	Every 1000 Hours	Customer	Dealer
Dozer blade	x					x	
Swivel console	x					x	
Boom	x					x	
Dipper arm	x					x	
Attachments	x					x	
Chassis (front of undercarriage)	x					x	

Lubricate daily at the points indicated

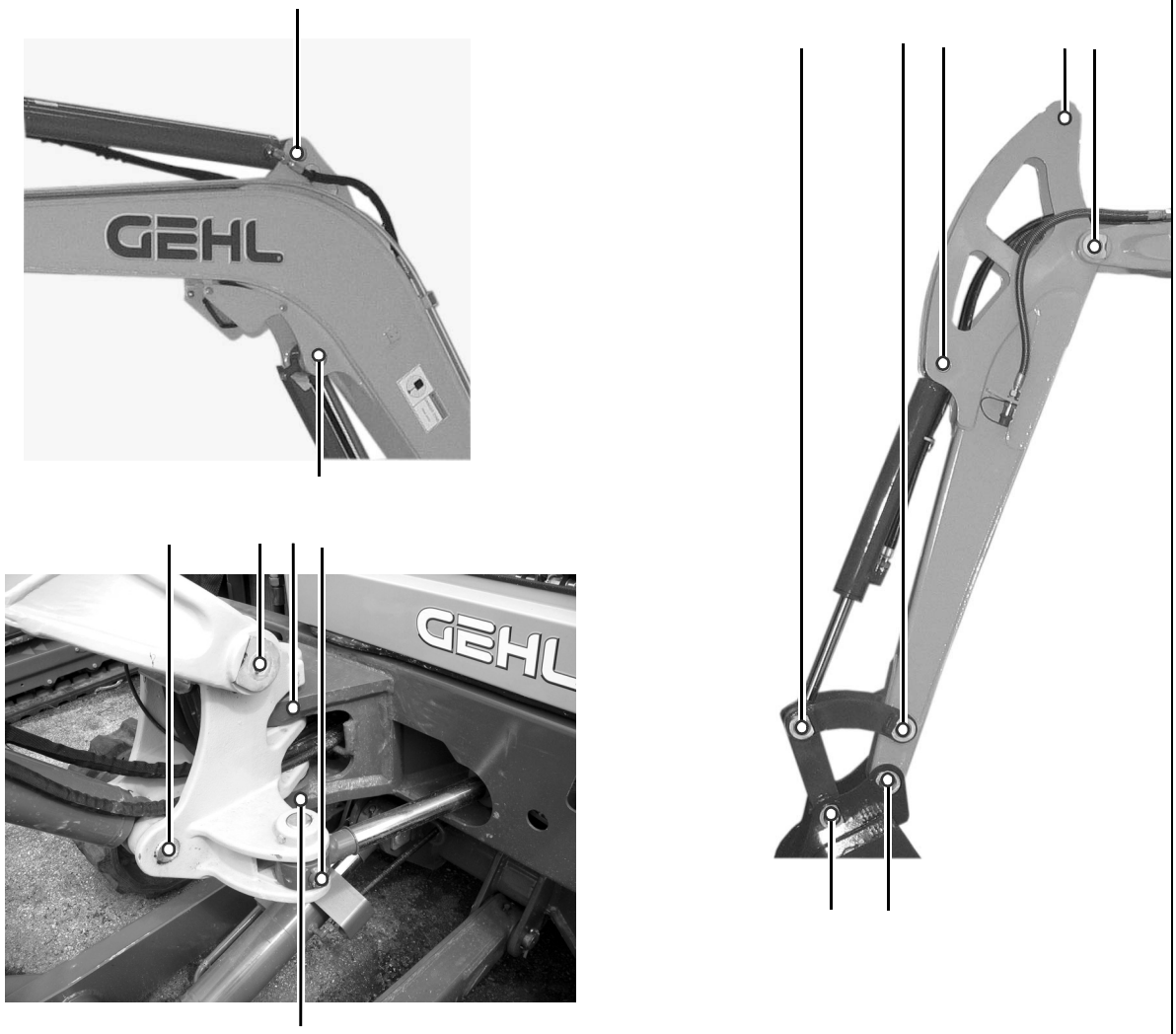


Figure 4-1 Lubrication Points

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Lubricate daily at the points indicated

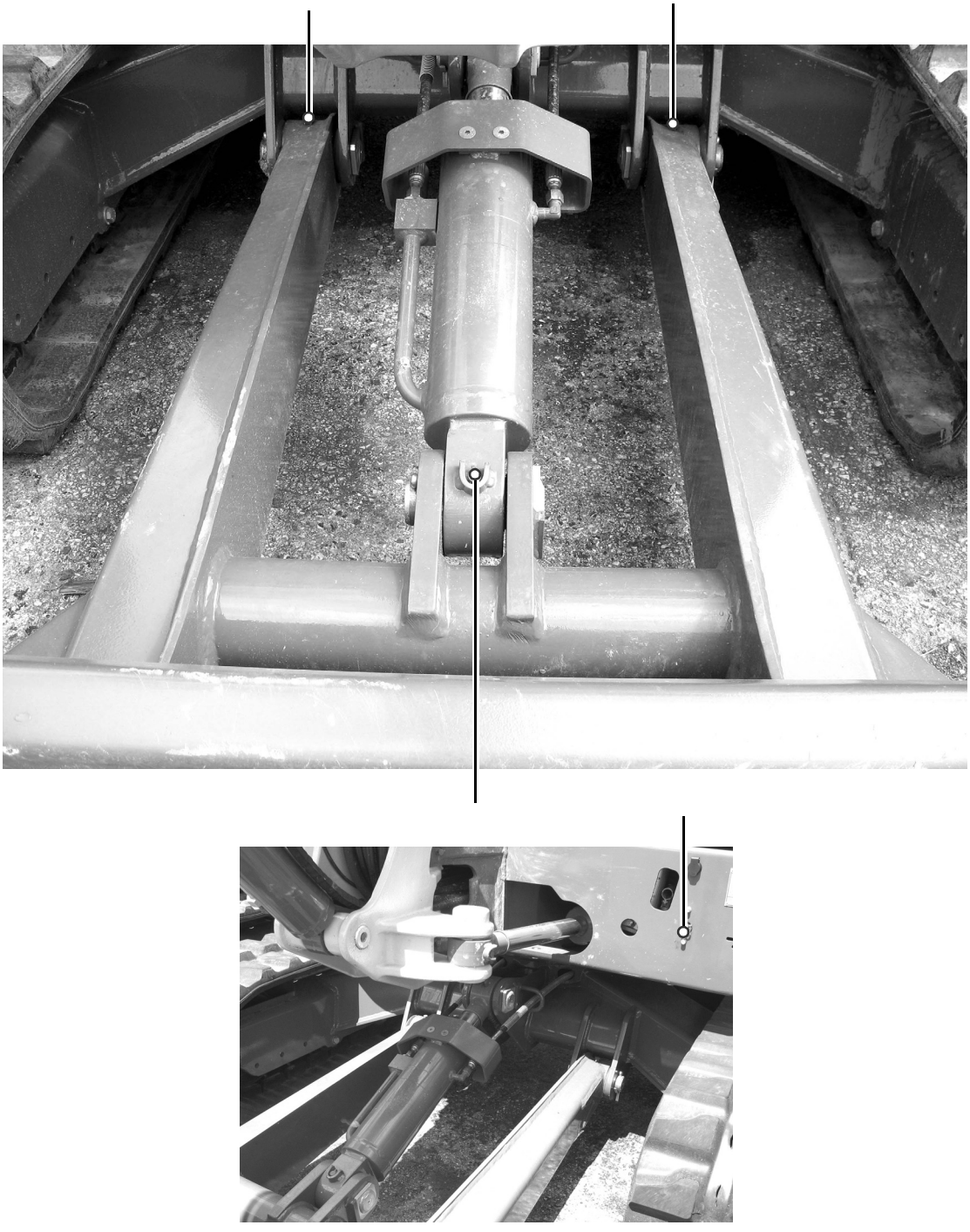


Figure 4-2 Lubrication Points (continued)

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Recommended Lubricants

Engine Oil

IMPORTANT

Be sure to read the engine manual supplied with this machine for detailed engine specifications.

See *"Fluid Capacities/Lubricants"* on page 1-4 for proper engine oil specifications.

Hydraulic Oil

See *"Fluid Capacities/Lubricants"* on page 1-4 for proper hydraulic oil specifications.

Swing Ring

Lubricate with a heavy-duty lithium complex grease with 3% molybdenum disulfide, such as Chevron RPM Heavy Duty Grease No. 2, Mobilgrease Moly 52 or BP Energrease Moly EP2.

Final Drive Unit

An EP grade gear oil that conforms to API GL5, such as Chevron Delo Gear 80-W90 or BP Transgear 80-W90 is required.

Swing Gear Unit

An EP grade gear oil that conforms to API GL5, such as Chevron Delo Gear 80-W90 or BP Transgear 80-W90 is required.

Lubrication Points

See Figures 4-1 and 4-2.

Apply a heavy-duty lithium complex grease with 3% molybdenum disulfide. See *"Fluid Capacities/Lubricants"* on page 1-4 for more detailed specifications.

Ranges of Applications

From –4° F to +104° F (-20° C to + 40° C) outside temperature.

Engine

Checking Engine Oil Level

IMPORTANT

See *"Fluid Capacities/Lubricants"* on page 1-4 for engine oil grade. To prevent damage to the engine, only use the engine oils specified, or oils of equivalent quality and grade.

To check the engine oil, the machine must be on a level surface with the engine turned off. Check the oil level before starting the engine or at least five minutes after shutting off the engine.

1. Push the engine cover latch button and raise the engine cover.
2. Check the engine oil level using the dipstick (1) located on the right side of the engine. See Figure 4-3.
3. Add oil if required through the oil filler neck (3). See Figure 4-3.
4. Drain excess oil if required. See *"Changing Engine Oil and Filter"* on page 4-11.

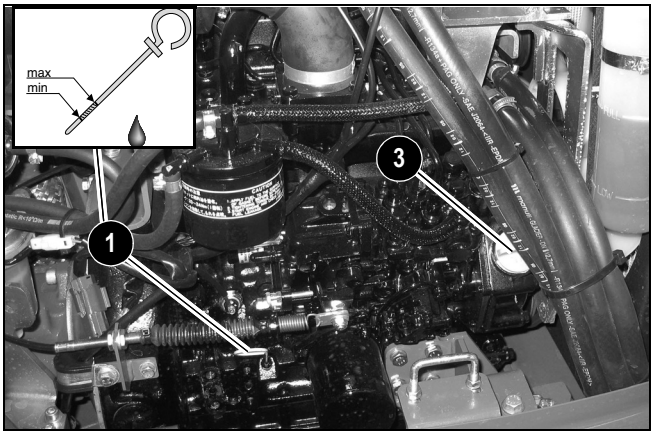


Figure 4-3 Oil Dipstick and Filler Neck Locations

Note: *Marks on the dipstick indicate the minimum and maximum oil levels.*

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Changing Engine Oil and Filter

1. Perform the *"Mandatory Safety Shutdown Procedure*" on page 2-2, but do not allow the engine to fully cool; warm oil will drain more completely.

IMPORTANT

The machine must be postioned on a level surface for the oil to drain completely.

2. Push the engine cover latch button and raise the engine cover.
3. Position a waste oil collection container under engine oil pan.
4. Remove the drain plug from the oil pan and allow the oil to drain into the waste oil collection container.

IMPORTANT

Dispose of waste engine oil according to environmental laws or take to a recycling center for proper disposal. DO NOT pour waste engine oil onto the ground or down a drain.

5. Remove the oil filter, using a filter wrench as necessary. See (1) Figure 4-4.

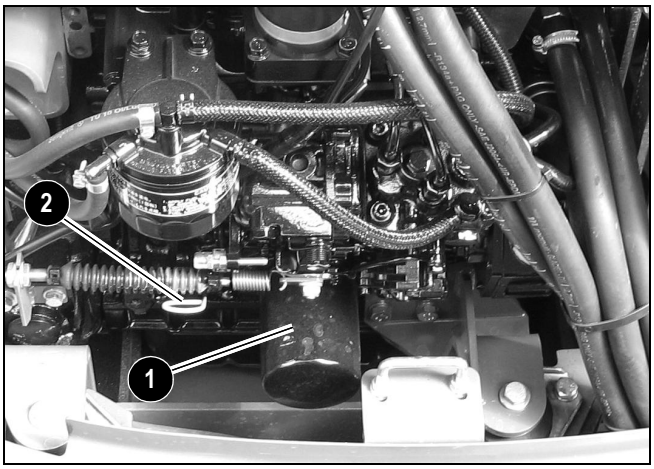


Figure 4-4 Oil Filter Location

6. Clean the filter housing surface. Put a film of clean oil on the filter gasket. Install the new filter and tighten 1/2 rotation past where the filter contacts the filter mounting surface.
7. Reinstall the drain plug.
8. Clean the area around the oil filler cap.
9. Remove the oil filler cap and raise the oil dipstick (2) slightly to allow any trapped air to escape.
10. Add new oil through the oil filler cap opening. Crankcase capacity with filter is approimately 7.5 qts. (7.1 L). Do NOT fill crankcase above the MAX mark on the dipstick.
11. Reinstall oil filler cap.
12. Wait about 3 minutes to allow the oil to run into the oil sump and check the oil level according to *"Checking Engine Oil Level*" on page 4-10.
13. Start the engine and let it run for several minutes. Watch the engine oil light on the control panel. The light should turn off after several seconds. If it does not, shut off the engine, determine the cause and fix the problem before restarting the engine.
14. Stop the engine and check for leaks at the oil filter and oil drain plug.
15. Check the oil level again and add oil if necessary.

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Air Cleaner

1. Perform the *"Mandatory Safety Shutdown Procedure"* on page 2-2, but do not allow the engine to fully cool; warm oil will drain more completely.
2. The air cleaner is located under the engine cover. Press the engine cover release button and raise the engine cover.
3. Release the bow clips (1) to remove the air cleaner cover and gasket (2). See Figure 4-5.
4. Carefully remove outer air cleaner element (3). See Figure 4-5. Carefully remove inner air cleaner element (3). Clean the inside of the air cleaner housing components with a lint-free cloth. Clean all contamination, dirt and dust from inside the upper and lower air cleaner housing and cover.
5. Replace both the inner and outer air cleaner elements when the indicator light comes on. See *"Fluid and Filter Changes"* on page 4-6.
6. Reinstall air cleaner elements (3, 4), gasket and air cleaner cover (2). Fasten bow clips (1).
7. Close and secure engine cover.

IMPORTANT

Do not knock the element against a solid object to remove dust. The element may become distorted and damaged.

IMPORTANT

Do not operate engine without the air cleaner components installed or damage to the engine could occur.

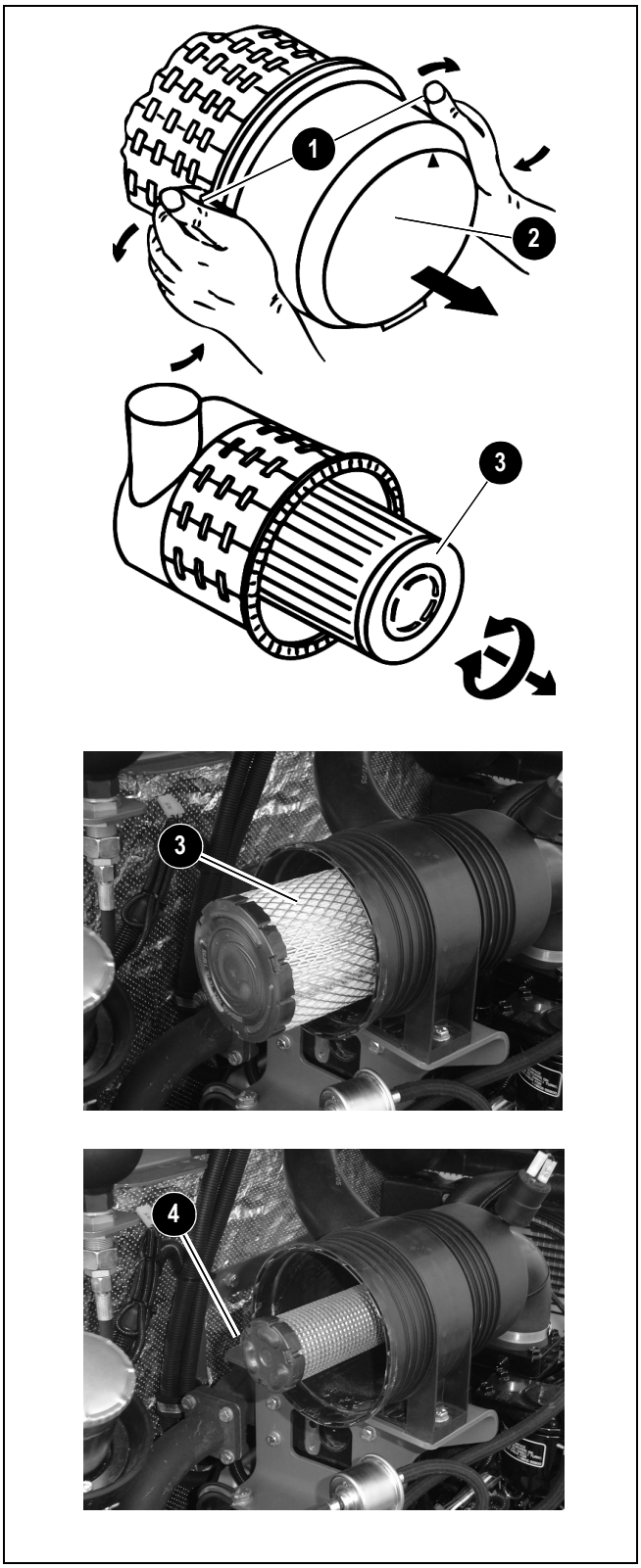


Figure 4-5 Air Filter Service

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Fuel System

Filling the Fuel Tank

WARNING

Stop the engine and allow it to cool before filling the fuel tank. NO SMOKING! Failure to obey warnings can cause an explosion or fire.

The fuel level in the tank is indicated by the fuel gauge (1) on the console. See Figure 4-6.

The fuel tank inlet is located inside the engine compartment. To fill the tank, push the engine cover latch button, raise the engine cover and remove the fuel filler cap (2). See Figure 4-6. Fill the fuel tank with clean diesel fuel with a cetane rating over 45. After fueling, re-install fuel cap, and close and latch the engine cover.

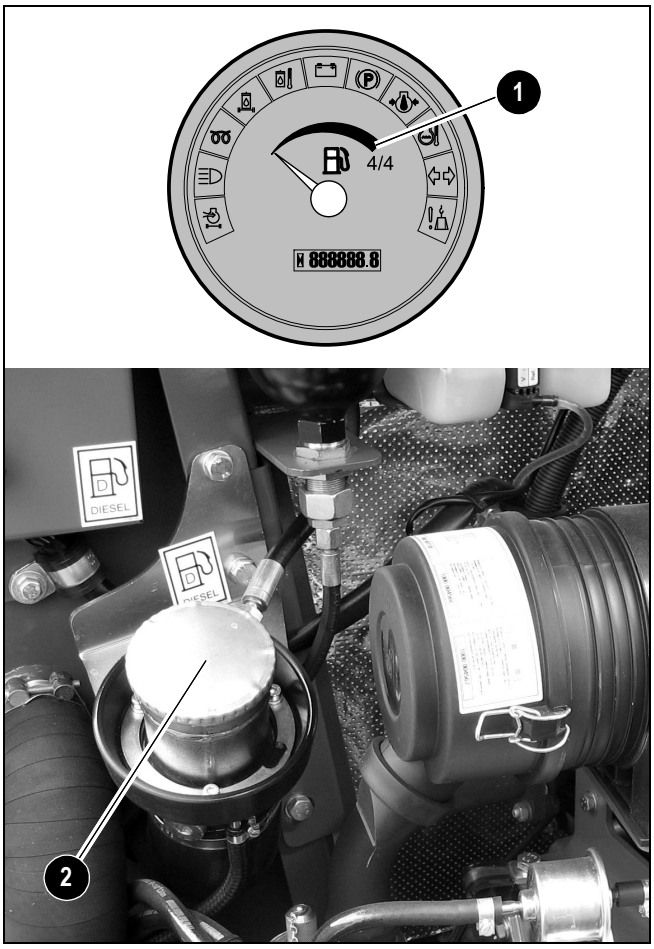


Figure 4-6 Fuel Gauge and Fuel Filler Cap

IMPORTANT

Unless draining fuel tank for servicing, never operate the machine until the fuel tank is completely empty. The fuel system has to be bled of air whenever the fuel tank is run empty. Always fill the fuel tank after use.

IMPORTANT

When using the machine in cold weather, it is important to use the proper fuel blend to prevent the fuel "gelling". See the engine operator's manual for fuel blend infomation related to temperature. Fuel gelling can permanently clog the fuel filter and water separator elements, requiring replacement.

WARNING

Always clean up spilled fuel and oil. Keep heat, flames, sparks and lighted tobacco away from fuel and oil. Failure to use care around combustibles can cause explosion or fire, which can result in injury or death.

DANGER

When handling fuel, there is a high risk of fire. Never work on the fuel system around open flames or sparks. DO NOT smoke when working on the fuel system or refueling. Before refueling, turn off the engine and remove the ignition key. Do not refuel in closed rooms. Wipe up fuel spills immediately. Keep the machine clean to reduce the risk of fire.

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Fuel Filter

⚠ WARNING

Use care to catch any spilled fuel when servicing the fuel filter. Spilled fuel can cause a fire.

The fuel filter is located approximately mid-way between the engine oil filter and the air cleaner.

1. Before servicing the fuel filter, perform the *"Mandatory Safety Shutdown Procedure*" on page 2-2.
1. Twist the fuel shut-off valve lever (2, Figure 4-8) on the water separator to the "OFF" position, as shown.
2. Clean dirt from the housing and unscrew the fuel filter (1, Figure 4-7).
3. Remove and discard the old fuel filter properly.
4. Clean around the filter housing.
5. Coat the seal on the new fuel filter with clean engine oil.
6. Install the new fuel filter and tighten 1/2 rotation past where the filter contacts the filter mounting surface.
7. Twist the fuel shut-off valve (2, Figure 4-8) on the water separator to the "ON" position.

The fuel system must be purged of air after changing the fuel filter, or if the fuel tank has been run dry. See *"Purging Air from the Fuel System*" on page 4-14.

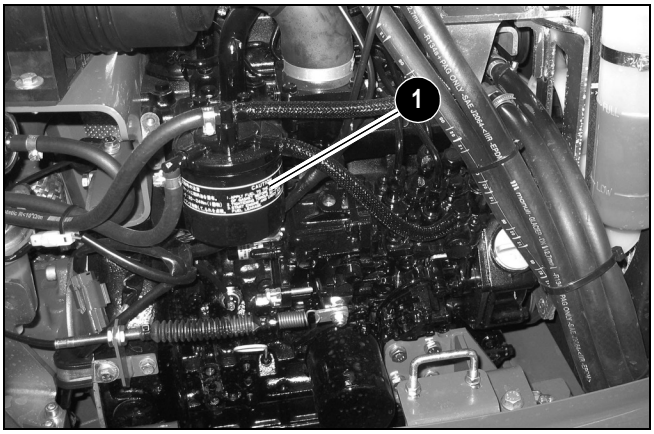


Figure 4-7 Fuel Filter

Fuel Shut-off Valve and Water Separator

If water is seen in the water separator bowl or the indicator ring rises to position (4, Figure 4-8), the bowl will need to be drained.

Note: *The water separator is located on the engine below the air cleaner.*

1. Twist the fuel shut-off valve lever (2) on the water separator to the "II" (OFF) position, as shown.

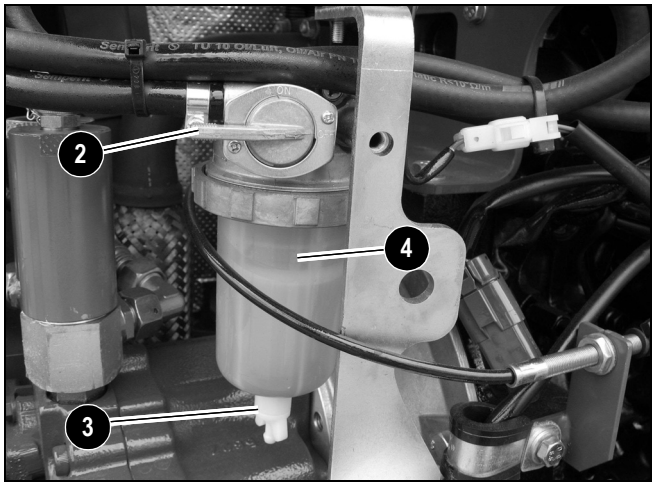


Figure 4-8 Fuel Shut-off Valve, Fuel Pre-filter and Water Separator (Shut-off valve in "OFF position)

2. Unscrew plug (3) and collect the water that drains out of the water separator. Allow water to drain until the indicator ring reaches the bottom of the water separator.
3. Tighten plug (3) and discard fuel/water according to environmental laws. DO NOT pour fluids onto the ground or down a drain.
4. Twist the fuel shut-off valve (2) on the water separator to the "I" (ON) position.

Purging Air from the Fuel System

⚠ WARNING

DO NOT bleed air on a hot engine. Spilled fuel can cause a fire.

Starting from the fuel tank, the fuel system runs through the water separator, fuel filter, fuel injection pump and high pressure piping to the fuel injection nozzles. If the fuel tank is run dry, or if the fuel filter, water separator or fuel lines are replaced, trapped air must be removed, or bled, from the fuel system.

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Bleed air from the fuel system according to the following steps:

1. Fill the fuel tank.
2. Make sure that the valve on the water separator valve (1, Figure 4-9) is in the "ON" position.

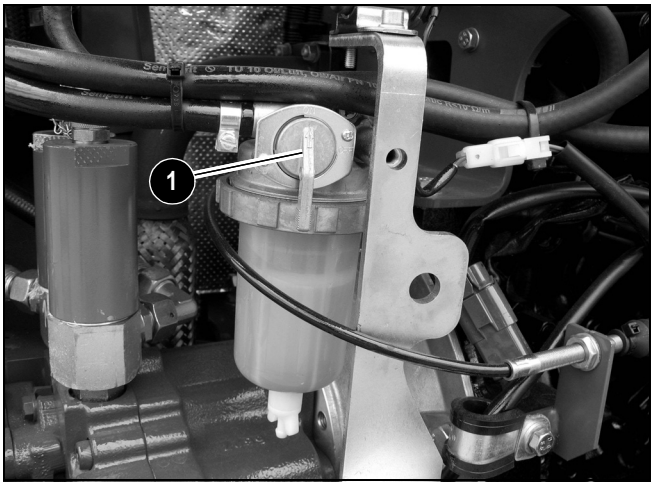


Figure 4-9 Fuel Shut-off Valve in "ON" Position

3. Turn the ignition key to the "I" (ON) position.
4. Wait about five minutes while the fuel system bleeds itself.
5. Start the engine.

If the engine runs smoothly and then stops, or if it does not run smoothly, switch off the engine and bleed the system again as described in this procedure. If the engine still does not run smoothly, contact your dealer.

Cooling System

Checking Coolant Level

Note: *The engine must be cold.*

1. Press the engine cover release button and raise the engine cover.
2. Check the coolant level in the expansion reservoir. If the coolant level is low (2, Figure 4-10), remove the reservoir cap and overflow tube.
3. Fill reservoir to FULL line (1). Refer to *"Fluid Capacities/Lubricants"* on page 1-4 for the correct coolant type and to *"Coolant Compound Table"* on page 1-8 for the correct coolant mixture. Replace the reservoir cap.

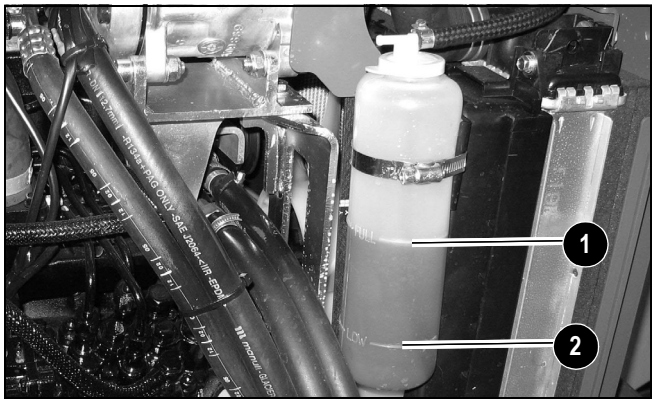


Figure 4-10 Coolant Expansion Reservoir

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Electrical System

⚠ WARNING

Inspect and check the machine's electrical equipment at regular intervals. Defects, such as loose connections or scorched cables much be repaired before using the machine.

Work on the machine's electrical system must be done only by a trained technician.

Fuses

The fuse panel (1, Figure 4-11) is located in the side of the kick panel, below the seat.

The main fuse (2) is located in the electrical box in the upper left engine compartment. See *"Main Fuse Box with Relays*" on page 1-7.

To replace a fuse, remove the panel cover and pull the old fuse from the socket. Install a new fuse of the same rating and re-install the fuse panel cover.

IMPORTANT

Blown fuses indicate electrical system malfunctions. Determine what caused the fuse to blow and repair the problem before replacing the fuse.

Note: *Additional fuse identification information can be found on pages 1-7 to 1-8.*

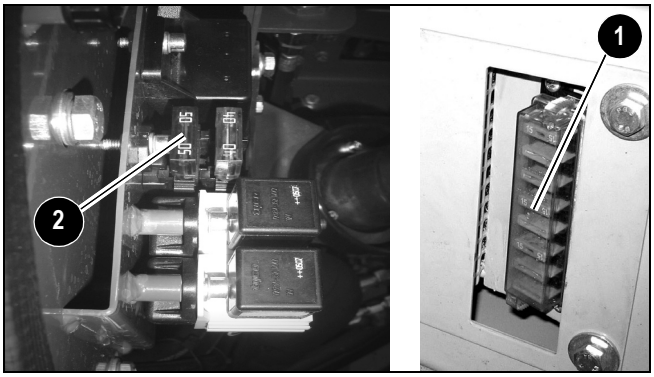


Figure 4-11 Fuse Panel

Battery

⚠ WARNING

Before servicing the battery or electrical system, disconnect battery from the electrical system by turning the battery disconnect switch to the "OFF" position.

Explosive gas is produced while a battery is in use or being charged. Keep flames or sparks away from the battery area. ALWAYS charge the battery in a wellventilated area.

Do not jump-start a frozen battery, or it may explode. A discharged battery can freeze at 14°F (10°C).

To prevent short circuits keep metal parts on your clothing and metal watchbands away from the positive (+) terminal of the battery.

⚠ WARNING

Never lay a metal object on top of a battery, because a short circuit can result. Battery acid is harmful to skin and fabrics. If acid spills, follow these first-aid tips:

Immediately remove any clothing on which acid spill.

- **If acid contacts skin, rinse the affected area with running water for 10 to 15 minutes.**
- **If acid contacts eyes, flood eyes with running water for 10 to 15 minutes. See a doctor at once. Never use any medication or eye drops unless prescribed by the doctor.**
- **To neutralize acid spilled on the floor, use one of the following mixtures:**
  - **0.5 kg (1 lbs.) of baking soda in 4 L (4 qts.) of water.**
  - **0.5 L (0.5 qts.) of household ammonia in 4 L (4 qts.) of water.**

In case of acid contact, wash immediately with water for several minutes. In case of eye contact, get medical attention immediately.

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The battery is located under the cab near the rear of the undercarriage. See 1, Figure 4-12. Refer to *"Tilting the cab or canopy"* on page 3-10 for how to tilt and secure the cab to gain access to the battery.

Battery cables must be clean and tight. Remove any acid or corrosion from the battery and cables using a sodium bicarbonate and water solution. Cover the battery terminals and cable ends with battery-saver grease.

Note: *The battery is maintenance-free and requires no other service.*

Using a Booster Battery (Jump-Starting)

⚠ WARNING

- **Keep arcs, sparks, flames and lighted tobacco away from batteries. When jump-starting from a booster battery, make final connection (negative) at engine frame away from the battery. Batteries can create flammable gases. Sparks or open flames can cause this gas, and the battery, to explode.**
- **DO NOT jump-start or charge a frozen battery. Warm battery to 60°F (16°C) before connecting to a charger. Unplug charger before connecting or disconnecting cables to battery.**



Figure 4-12 Battery Location

IMPORTANT

When jump-starting from another machine, be sure the second machine is not running if the glow plugs are used on unstarted machine. High voltage spikes from a running machine can burn out the glow plugs.

IMPORTANT

Damage to the alternator can occur if:

- **the engine is operated with the battery cables disconnected,**
- **the battery cables are connected when using a fast charger or when welding on the machine (When welding on the machine, remove both cables from the battery and ground the welder to the machine frame near the repair area), or**
- **battery booster cables are connected incorrectly.**

IMPORTANT

The booster battery must be 12 volt.

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Jump-start Procedure:

1. Turn ignition key on the machine with the discharged battery to the “P” position.
2. Open the engine cover.
3. Connect one end of a jumper cable to the positive (+) terminal on the booster battery.
4. Connect the other end of the same cable to the positive (+) terminal on the battery disconnect switch (1, Figure 4-13) of the machine with the discharged battery.
5. Connect one end of the second jumper cable to the negative (-) terminal on the booster battery.
6. Connect the other end of the same cable to the frame of the machine with the discharged battery.

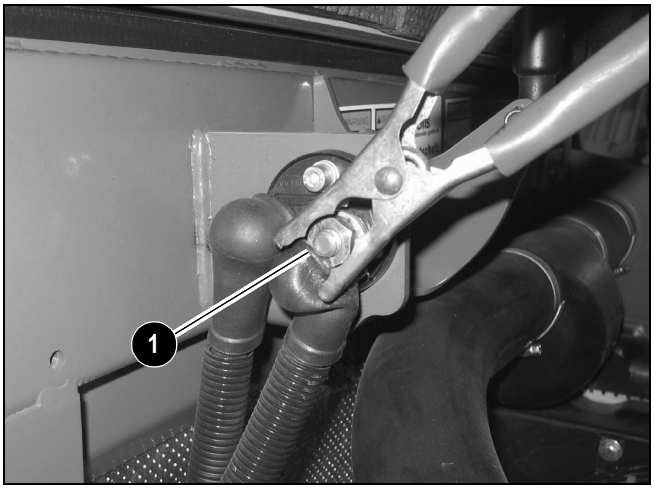


Figure 4-13 Jump-starting

Start the engine of the machine with the discharged battery. Once the engine is running, remove the cable connected to the frame first. Disconnect the other cable from the positive (+) terminal on the battery disconnect switch. Remove the cables from the booster battery last.

IMPORTANT

DO NOT allow the booster cable ends to touch when removing them from the batteries. Arcs and direct short circuits can cause severe damage to electrical components.

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Hydraulic System

⚠ WARNING

The hydraulic reservoir is under pressure. Never use your hands to search for hydraulic fluid leaks; use a piece of paper or cardboard to find leaks. Escaping fluid under pressure can be invisible and can penetrate the skin, causing serious injury. If any fluid is injected into your skin, see a doctor at once. Injected fluid MUST be surgically removed by a doctor familiar with this procedure, or gangrene may result.

Checking Hydraulic Oil Level

1. Position the machine on a level surface.
2. Fully extend the bucket and boom, retract the arm and position as shown in Figure 4-14.
3. Lower the bucket and dozer blade to the ground. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
4. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.

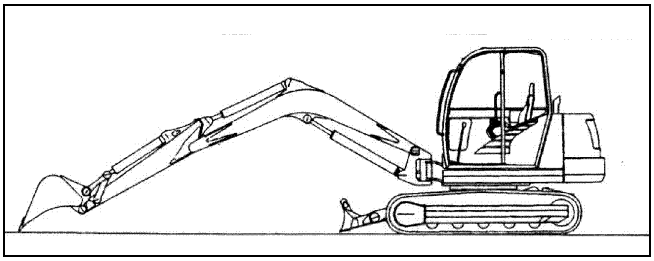


Figure 4-14 Excavator Position for Checking and Changing Hydraulic Oil

5. Check the hydraulic oil level sight gauge (1, Figure 4-15). Oil level should be approximately at the point shown at (2).
6. If the hydraulic oil level is low:
   a. Open the engine cover.
   b. Slowly loosen the breather cap (3) with a cloth to relieve pressure. Re-tighten the breather cap after relieving pressure. Slowly open the hydraulic oil filler cap (4) and then remove the cap.

Note: *A short hex shaft is included in the tool kit. This tool is designed to be used with a standard ratchet wrench to open the filler cap.*

   c. With the filter insert (5) in place, add hydraulic oil until the oil level is between the marks on sight gauge (1).

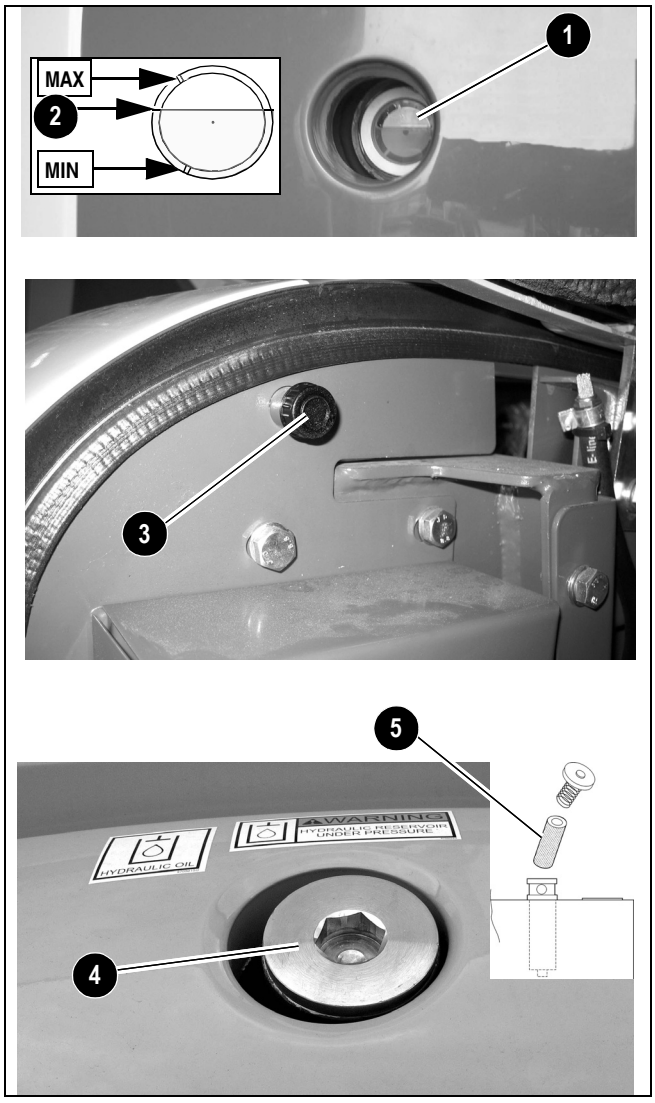


Figure 4-15 Hydraulic Reservoir

   d. Re-install the hydraulic oil filter insert and filler cap and tighten them securely.
   e. Start the engine and let it idle for a few minutes.
   f. Check hydraulic functions. Repeat this procedure to recheck the hydraulic oil level. Add oil if necessary.

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Changing Hydraulic Oil

1. Position the machine on a level surface.
2. Fully extend the bucket and boom, retract the arm and position as shown in Figure 4-14.
3. Lower the bucket and dozer blade to the ground. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
4. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
5. Slowly loosen the breather cap (3) with a cloth to relieve pressure. Re-tighten the breather cap after relieving pressure. Slowly open the hydraulic oil filler cap (4). Remove the cap and the filter insert (5).

IMPORTANT

The filler cap and filter assembly will be removed over the rear cover. Protect the rear cover from spilled or dripping hydraulic fluid.

6. Open the reservoir drain plug and drain the oil into a suitable container. Re-install the drain plug and tighten securely.

IMPORTANT

Always dispose of hydraulic fluids according to environmental laws or take to a recycling center for proper disposal. DO NOT pour onto the ground or down a drain.

7. Reinstall filter insert (5).
8. Fill the reservoir with hydraulic oil until oil level is between marks on sight gauge.
9. Re-install the hydraulic filler cap (2) and tighten securely.
10. Start the engine and let it idle for a few minutes. Cycle all front attachment hydraulic functions and check the hydraulic oil level according to *"Checking Hydraulic Oil Level*" on page 4-19.

Hydraulic Cooling System

The hydraulic system uses a hydraulic cooler to keep the hydraulic fluid at the proper temperature. The cooler is located inside the engine compartment near the engine radiator. Inspect the cooler for leaks or damage.

Pilot Valve

IMPORTANT

Hydraulic oil contamination can damage pilot valve control spools. Check the pilot control valve filter/restrictor every 1000 hours (every other oil change) and clean if necessary. Replace the filter/restrictor if it is damaged in any way.

Checking Pilot Control Valve Filter:

1. Position the machine on a level surface.
2. Fully extend the bucket and boom, retract the arm and position as shown in Figure 4-14.
3. Lower the bucket and dozer blade to the ground. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
4. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
5. To relieve pressure, slowly loosen the breather cap (3) with a cloth. Re-tighten the breather cap after relieving pressure.
6. Tilt the cab/canopy according to *"Tilting the Cab or Canopy*" on page 3-10.
7. Disconnect hose (A, Figure 4-16) connected to the pilot control filter/restrictor fitting (B) on the side of a joystick control valve.

IMPORTANT

Hydraulic oil will leak during procedure. Place absorbent material under valve to catch leaking oil. Always dispose of hydraulic fluids according to environmental laws or take to a recycling center for proper disposal.

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8. Disconnect the pilot control filter/restrictor fitting (B) from the valve.

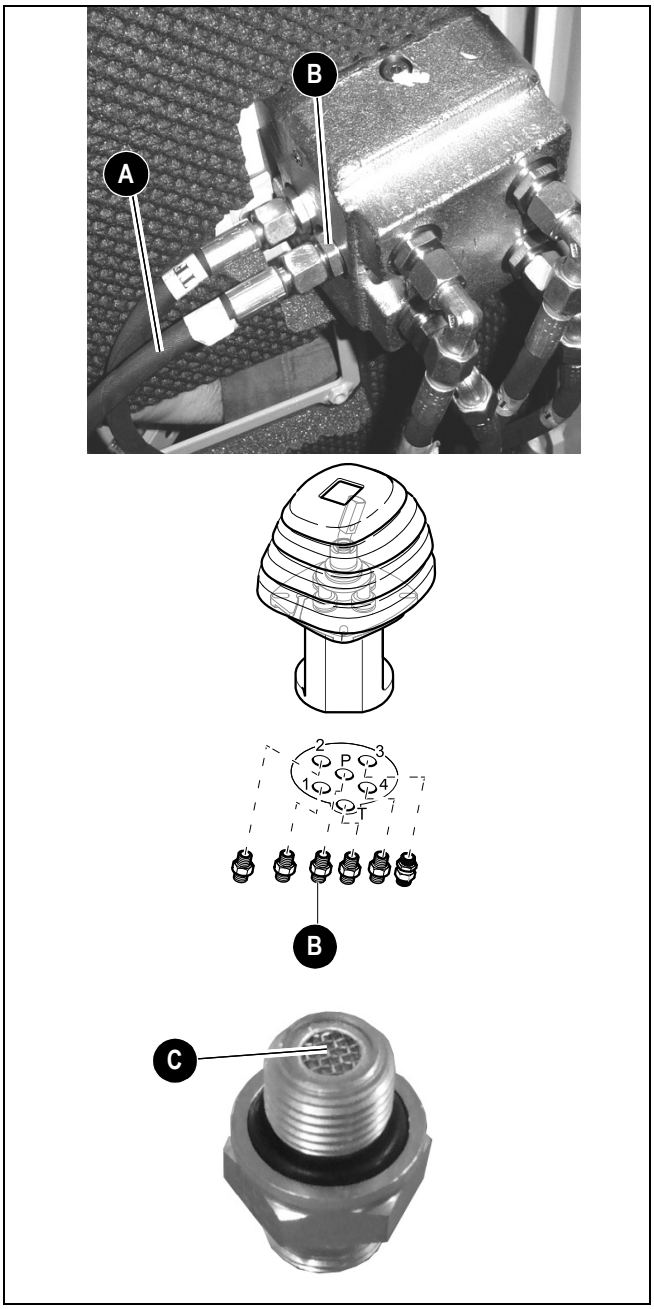


Figure 4-16 Pilot Control Filter/Restrictor

9. Check the filter/restrictor fitting filter screen (C) for contamination/dirt and clean if necessary. Replace the filter/restrictor if it is damaged.
10. Replace filter/restrictor fitting (B) back into the valve, and reconnect hose to the filter/restrictor (C). Tighten securely.
11. Repeat steps 7-10 for the other joystick control valve.
12. Tilt the cab/canopy down according to *"Tilting the Cab or Canopy"* on page 3-10.

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Hydraulic Hose Maintenance

⚠ WARNING

- **Hydraulic hoses and connections must be inspected by a trained technician before the first use of the machine, and at least annually thereafter, for leaks and/or damage.**
- **Leakages and damaged pressure lines must be immediately repaired or replaced by an authorized service center.**
- **Never use your hands to check for suspected hydraulic leaks. Always use a piece of wood or cardboard.**
- **Leaks from hydraulic hoses or pressurized components can be difficult to see, but pressurized oil can have enough force to pierce the skin and cause serious injury.**
- **Obtain immediate medical attention if pressurized oil pierces the skin. Failure to obtain prompt medical assistance could result in gangrene or other serious damage to tissue.**
- **Always relieve hydraulic system pressure before performing any maintenance on the machine. Do not tighten leaking connections when the hydraulic system is under pressure.**
- **Never weld or solder damaged or leaking pressure lines and/or screw connections. Always replace damaged hydraulic components.**
- **Hydraulic hoses must be replaced every six years from the date of manufacture, even if they do not appear damaged. The date of manufacture (month or quarter and year) is indicated on hydraulic hoses. See Figure 4-17.**

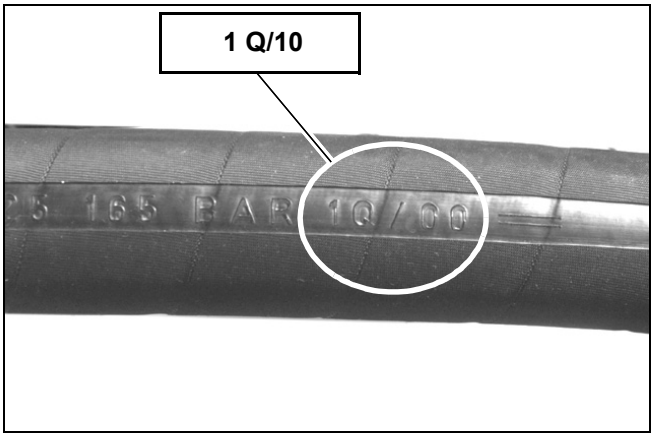


Figure 4-17 Hydraulic Hose Manufacture Date

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Checking and Adjusting V-belt Tension

1. Position the machine on a level surface.
2. Lower the bucket and dozer blade to the ground. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
3. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console. Wait for the engine to cool down.
4. Press the engine cover release button and raise the engine cover. Carefully inspect the V-belt (1) for damage. If the V-belt (1) is damaged, have it replaced by your dealer.
5. Press on the center of a span on the V-belt to check deflection. The belt deflection should be no more than 5/16” (8 mm). See Figure 4-18.
6. If deflection is more than 5/16” (8 mm):
   a. Loosen adjustment bolt (2) and rotate the alternator (3) in the direction of the arrow until V-belt tension is correct.
   b. Tighten adjustment bolt (2) and re-check V-belt tension.

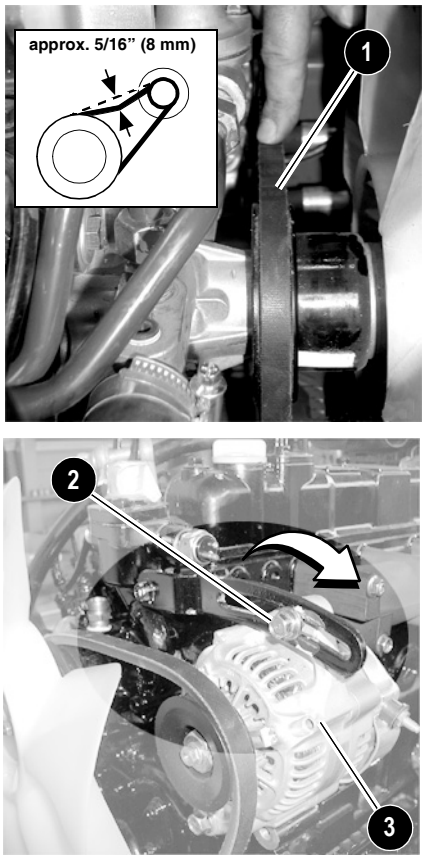


Figure 4-18 Checking & Adjusting V-belt Tension

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Checking and Adjusting Air Conditioning V-belt Tension

1. Position the machine on a level surface.
2. Lower the bucket and dozer blade to the ground. Move the joysticks in all directions to verify the hydraulic system is de-pressurized.
3. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console. Wait for the engine to cool down.
4. Press the engine cover release button and raise the engine cover. Carefully inspect the air conditioning V-belt (1) for damage. If the V-belt (1) is damaged, have it replaced by your dealer.
5. Press on the center of a span on the air conditioning V-belt to check deflection. The belt deflection should be no more than 3/8" (9 mm). See Figure 4-19. If deflection is more than 11/32" (9 mm):
   a. Loosen bolt (2) and pull down on the belt tensioner (3) until the correct V-belt tension is correct.
   b. Tighten bolt (2) and re-check V-belt tension.

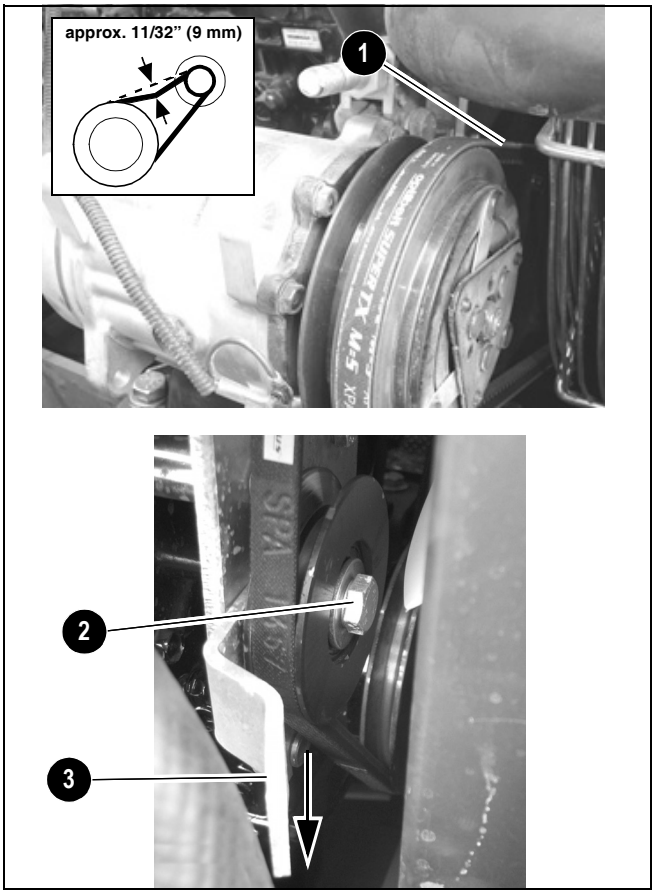


Figure 4-19 Checking & Adjusting Air Conditioning V-belt Tension

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Track System

Track Cleaning

If dirt or mud builds up in the track frame, raise the track frame using the boom and dipper arm and then rotate the elevated track to clean it. Be sure that the build-up has been cleared from the track. Repeat for the other track. See Figure 4-20.

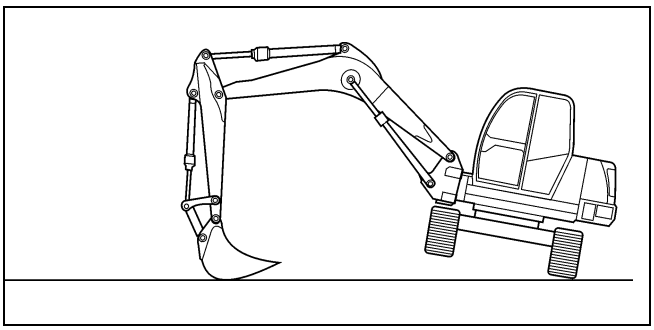


Figure 4-20 Track Cleaning

Note: *When using the boom and dipper arm to lift any portion of the machine, roll the bucket until the round base is against the ground. The angle of the arm to the boom should be at 90º. See Figure 4-20.*

Changing Final Drive Oil

1. Position the machine on a level surface with final drive plugs positioned as shown in *"Drain Position"* in Figure 4-21.
2. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
3. Open both plugs and drain the oil into a suitable container. Re-install plugs.

IMPORTANT

Always dispose of oil according to environmental laws or take to a recycling center for proper disposal. DO NOT pour fluids onto the ground or down a drain.

4. Start the engine and move the machine slightly until plugs are positioned as shown in *"Fill Position"* in Figure 4-21.
5. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
6. Remove both screw plugs. Pour fresh oil (Chevron Delo Gear 80-W90 or BP Transgear 80-W90) into the top hole until oil starts to run out of the bottom hole.
7. Re-install both plugs securely.

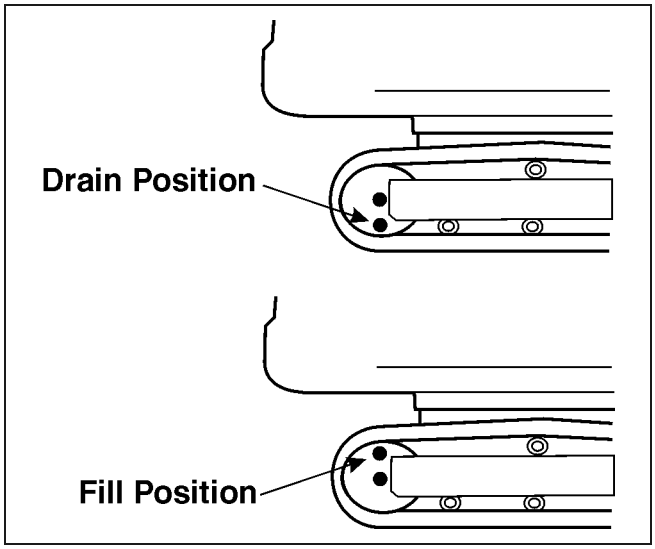


Figure 4-21 Track Final Drive Oil Change

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Checking and Adjusting Track Tension

1. Position the machine on a level surface. On machines equipped with rubber tracks, position the excavator so the tracks are positioned with mark (1, Figure 4-22) on the top span of the track in between drive pinion (2) and track tension roller (3).

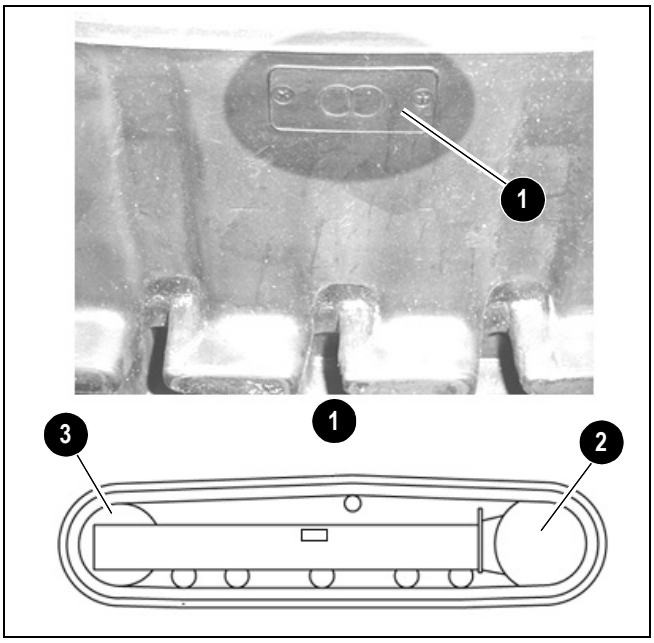


Figure 4-22 Rubber Track Tensioning Positioning

2. Use the bucket and dozer blade to lift the unit up until a track is just clear of the ground as shown in Figure 4-23.
3. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
4. Measure the clearance of the raised track at the second track roller from the drive gear. Deflection should be between 3/4-1" (20-25 mm).
5. Using a grease gun, pump grease into the fitting until the track is properly tensioned (Figure 4-23).

Note: *A grease gun is supplied with machine tool kit.*

IMPORTANT

Do not over-tension the track. If the track is too tight, loosen the grease fitting to relieve the pressure.

⚠ WARNING

Do not loosen the grease fitting more than two turns, or the fitting could be ejected under pressure and cause injury. Keep your face and body away from the fitting when loosening.

6. Start the engine. Lower the unit to the ground.
7. Repeat this procedure for the other track.

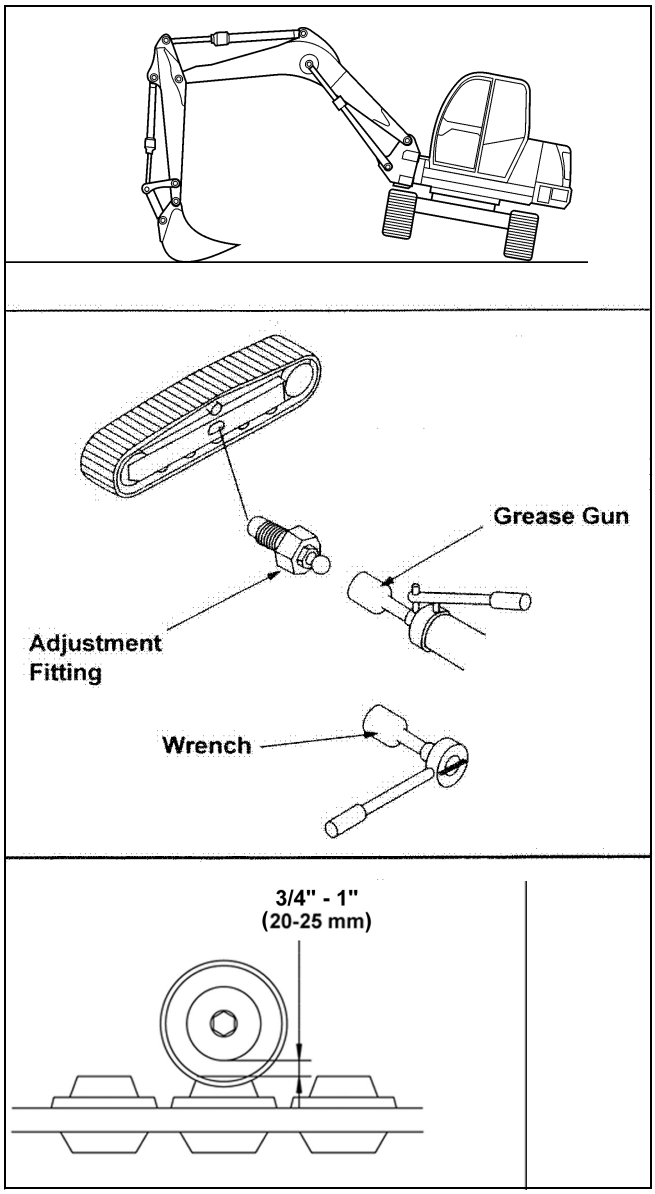


Figure 4-23 Track Adjustment

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Windshield Washer Fluid

1. Shut off the engine. Remove the ignition key and take it with you. Lock out the controls by raising left control console.
2. Press the engine cover release button and raise the engine cover.
3. Open the windshield washer reservoir cover (1, Figure 4-24) and fill the tank with windshield washer fluid.
4. Close the windshield washer tank cover securely.
5. Close and latch the engine cover.

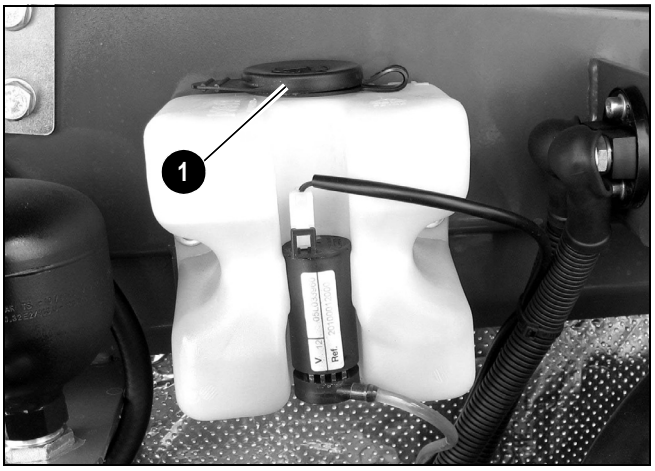


Figure 4-24 Windshield Washer Fluid Reservoir

LONG-TERM STORAGE

If storing the machine for a long period (longer than two months), perform the procedures in this section.

Before Storage

1. Wash the entire machine.
2. Lubricate all grease zerks. See *"Daily Lubrication*" on page 4-8.
3. Change the engine oil and filter according to *"Changing Engine Oil and Filter*" on page 4-11.
4. Add a fuel stabilizer to the fuel system according to the fuel supplier's recommendations.
5. Remove and fully charge the battery. Store the battery in a cool, dry location.
6. If the machine will not be operated for a month or longer, apply grease to all exposed hydraulic cylinder rod areas or retract all cylinders so rod exposure is minimized. Apply grease to any remaining rod areas.
7. If the ambient temperature (at any time during the storage period) is expected to drop below freezing, make sure the engine coolant is either completely drained from the radiator and engine block or that the amount of anti-freeze in it is adequate to keep the coolant from freezing. Refer to the engine manual for anti-freeze recommendations and quantities.
8. Protect against extreme weather conditions such as moisture, sunlight and temperature.

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During Storage

About once each month, connect the battery and check all fluid levels to make sure they are at the proper level before starting the engine.

Start the engine and allow it to run until it warms up and then move the machine a short distance to help relubricate the internal parts. Run the engine until the battery has a chance to recharge and then shut it off.

IMPORTANT

If it is desired to operate the hydraulic cylinders at this time, BE SURE to wipe the protective grease (and any adhering dirt) from the cylinder rods prior to starting the engine. After operating, BE SURE to recoat the cylinder rods with grease if the machine is to be returned to storage.

After Storage

After removing the machine from storage and before operating it, perform the following:

1. Replace and re-connect the battery.
2. Wipe off grease (and any adhering dirt) from cylinder rods.
3. Check V-belt tension.
4. Check all fluid levels and top-off as necessary.
5. Start the engine. Observe all indicators. If all indicators are functioning properly and reading normally, move the machine outside.
6. When outside, park the machine and let the engine idle for at least five minutes.
7. Shut off the engine and walk around machine. Make a visual inspection looking for evidence of leaks.
8. Review and re-familiarize yourself with all safety precautions starting on page 4-1.
9. Follow the starting and warm-up procedures according to starting on page 3-16.

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CHAPTER 5 – TROUBLESHOOTING

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ENGINE

Problem	Possible Cause	Corrective Action
Engine hard -starting or fails to start	No fuel	Add fuel to tank; bleed air from fuel system
	Incorrect engine oil SAE grade	Replace engine oil with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
	Incorrect fuel grade	Replace fuel with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
	Loose, or corroded starter circuit connections	Repair starter circuit; contact authorized service center
	Incorrect engine clearance	Adjust clearance; contact authorized service center
	Battery power insufficient	Charge battery or replace if necessary. See "Battery" on page 4-16
	Fuel filter contaminated	Replace fuel filter; see "Fuel Filter" on page 4-14
	Malfunctioning fuel injector(s)	Repair fuel injector(s); contact authorized service center
	Starter not working / pinion fails to engage	Repair starter/pinion; contact authorized service center
	Glow plug system not working	Repair glow plug system; contact authorized service center
Rough running engine	Incorrect fuel grade	Replace fuel with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
	Incorrect engine clearance	Adjust clearance; contact authorized service center
	Fuel line leakage	Replace fuel line; contact authorized service center
	Malfunctioning fuel injector(s)	Repair fuel injector(s); contact authorized service center.
Insufficient engine power	Fuel line leakage	Replace fuel line; contact authorized service center
	Air filter contaminated	Service air filter; see "Air Cleaner" on page 4-12
	Engine not at operating temperature	Warm up the engine
	Incorrect fuel grade	Replace fuel with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
	Incorrect engine clearance	Adjust clearance; contact authorized service center
	Oil level too high	Adjust oil level; see "Changing Engine Oil and Filter" on page 4-11
	Malfunctioning fuel injector(s)	Repair fuel injector(s); contact authorized service center
	Engine overheated.	Check cooling system

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Problem	Possible Cause		Corrective Action
Engine overheats	Oil level too low		Add engine oil; see "Checking Engine Oil Level" on page 4-10
	Fouled oil cooler fins		Clean oil cooler; contact authorized service center
	Damaged fan. Damaged or loose V-belt		Replace the fan / service V-belt; see "Checking and Adjusting V-belt Tension" on page 4-23 or "Checking and Adjusting Air Conditioning V-belt Tension" on page 4-24; contact authorized service center
	Coolant level too low		Add coolant; see "Checking Coolant Level" on page 4-15
	Oil level too high		Adjust oil level; see "Changing Engine Oil and Filter" on page 4-11
	Oil level too low		Add engine oil; see "Checking Engine Oil Level" on page 4-10
	Malfunctioning fuel injector(s)		Repair fuel injector(s); contact authorized service center
High engine oil consumption	Oil level too high		Adjust oil level; see "Changing Engine Oil and Filter" on page 4-11
	Machine inclination too high		15° maximum inclination up and across slopes; 25° maximum inclination down slopes
	Incorrect engine oil SAE grade		Replace engine oil with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
Engine smoke	Blue	Oil level too high	Adjust oil level; see "Changing Engine Oil and Filter" on page 4-11
		Machine inclination too high	15° maximum inclination up and across slopes; 25° maximum inclination down slopes
	White	Incorrect fuel grade	Replace fuel with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
		Engine starting temperature too low	Wait for engine pre-heat cycle to complete before starting engine
		Incorrect engine clearance	Adjust clearance; contact authorized service center
		Malfunctioning fuel injector(s)	Repair fuel injector(s); contact authorized service center
	Black	Air filter contaminated	Service air filter; see "Air Cleaner" on page 4-12
		Incorrect engine clearance	Adjust clearance; contact authorized service center
		Malfunctioning fuel injector(s)	Repair fuel injector(s); contact authorized service center

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INDICATOR LAMPS

Problem	Possible Cause	Corrective Action
Engine oil pressure indicator light comes on during operation	Engine oil pressure too low	Stop engine immediately; check oil level and add oil if necessary; see "Checking Engine Oil Level" on page 4-10; if oil level is correct, oil pump may have failed
	Engine oil level too low	Add oil; see "Checking Engine Oil Level" on page 4-10
	Oil pump not working	Stop engine immediately; replace oil pump. Contact authorized service center
	Machine inclination too high	15° maximum inclination up and across slopes; 25° maximum inclination down slopes
	Incorrect engine oil SAE grade	Replace engine oil with proper grade; see "Fluid Capacities/Lubricants" on page 1-4
Water temperature display light comes on during operation (Engine overheating)	Coolant level too low	Add coolant; see "Checking Coolant Level" on page 4-15
	Fan blades rotating too slowly	Adjust V-belt tension; see "Checking and Adjusting V-belt Tension" on page 4-23 or "Checking and Adjusting Air Conditioning V-belt Tension" on page 4-24
	Air filter contaminated	Service air filter; see "Air Cleaner" on page 4-12
	Coolant system malfunction	Service cooling system; contact authorized service center
Battery voltage light comes on during operation	Alternator not charging properly / malfunctioning alternator	Adjust V-belt tension; see "Checking and Adjusting V-belt Tension" on page 4-23 or "Checking and Adjusting Air Conditioning V-belt Tension" on page 4-24; service alternator; contact authorized service center
	Loose, or corroded charging circuit connections	Repair charging circuit; contact authorized service center
Fuel light comes on	Low fuel	Add fuel
Air filter light comes on	Air filter contaminated	Service air filter; see "Air Cleaner" on page 4-12

SEALS AND HOSES

Problem	Possible Cause	Corrective Action
Oil, coolant or fuel leakage under engine	Loose hose connection(s)	Tighten hose connection(s)
	Seals or hoses damaged	Change seals or hoses and check engine oil, engine coolant or fuel levels; add engine oil, coolant or fuel if necessary
Hydraulic fluid losses from hydraulic system	Loose hose connection(s)	Tighten hose connection(s)
	Seals, hoses or lines damaged	Service seals, hoses and/or lines; contact authorized service center

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TRAVELING GEAR

Problem	Possible Cause	Corrective Action
Machine will not travel	Obstruction jamming track mechanism	Remove object
	Gears inoperative	Repair gear; contact authorized service center
Machine will not travel straight forward or backward	Obstruction jamming track mechanism	Remove object
	Unequal track tension	Adjust track tension; see "Checking and Adjusting Track Tension" on page 4-26
	Travel s damaged	Repair/replace s; contact authorized service center

BUCKET, BOOM AND DOZER BLADE

Problem	Possible Cause	Corrective Action
Swing frame rotation malfunc-tioning	Swing lock pin engaged	Release swing lock pin
	Insufficient lubrication	Lubricate swing gear using remote grease fitting
Front end attachments do not work or work only at a low performance level	Low hydraulic fluid level	Add hydraulic fluid; see "Checking Hydraulic Oil Level" on page 4-19
	Low engine power	See "Engine" troubleshooting on page 5-1; contact authorized service center
	Engine-to-pump coupling or hydraulic pump damaged	Contact authorized service center
	Pressure limiting s set too low	Contact authorized service center
	Hydraulic cylinder damaged	Contact authorized service center
	Control s damaged	Contact authorized service center
Hydraulic cylinders lower too quickly	Seals contaminated or damaged	Contact authorized service center
	Heavy internal leakage at control spools	Contact authorized service center
	Secondary cartridge s damaged	Contact authorized service center
Hydraulic lines overheat	Hydraulic oil filter blocked	Clean or replace filter
	Low hydraulic fluid level	Add hydraulic fluid; see "Checking Hydraulic Oil Level" on page 4-19
	Secondary cartridges set too low	Contact authorized service center
	Hydraulic fluid cooling system not in working order	Service hydraulic fluid cooling system; contact authorized service center

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Index

A

Air Conditioning 4-7
Auto-Idle 3-11
Auxiliary Hydraulics Connections 3-30
Auxiliary Hydraulics Operation 3-23

B

Battery 4-16
  Battery Disconnect Switch 3-7
  Jump-start Procedure 4-18

C

Cab Jack Handle 3-15
Checklists 1-14, 1-15
Cold-weather Starting 3-17
Component Names 1-3
Coolant Compound Table 1-8

E

Engine Shut-down 3-17
Engine Start-Up 3-17

F

Fuel Gauge and Fuel Filler Cap 4-13

G

General Information 1-1
Guards and Shields 3-1

H

Hydraulic Hose Maintenance 4-22

I

Ignition Key Switch 3-7
Introduction 1-1

L

Leakage Check 4-7
Lifting the Machine 3-31
Load Diagrams 1-10
  Long Dipper Arm 1-10
  Long Dipper Arm with Counterweight 1-11
  Short Dipper Arm 1-12
  Short Dipper Arm with Counterweight 1-13
Loading and Transporting 3-32
Long-Term Storage 4-27
Lubrication 4-7

M

Machine Orientation 3-1
  Boom Swivel Pedal 3-12
  Cab Door Latch 3-15
  Dozer Blade Lever 3-12
  Equipment and Controls 3-2
  Excavator Components 3-6
  Heat/Fan Controls 3-15
  Instrument Panel, Switches and Indicators 3-4
  Throttle Lever 3-11
  Travel Controls 3-8
  Windshield 3-14
Main Fuse Box with Relays 1-7
Maintenance 4-1
  Air Cleaner 4-12
  Air Conditioning 4-7
  Battery 4-16
  Cooling System 4-15
  Daily Lubrication 4-8
  Electrical System 4-16
  Engine 4-10
  Engine Oil and Filter 4-11
  Fuel System 4-13
  Hydraulic System 4-19
  Maintenance Label Symbols 4-3
  Maintenance Schedule 4-5
  Track System 4-25
  Troubleshooting 5-1
  V-belt 4-23
Maintenance Label 4-4
Mandatory Safety Shutdown Procedure 3-17

N

New Machine Break-in 3-18

O

Operation 3-21
  Boom Swivel 3-24
  Slope Operation 3-22

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https://truckmanualshub.com/

Index

Travel 3-18
Water Operation 3-23
Operational Safety 2-2
Ownership Change 1-2

P

Pilot Valve 4-20
Pilot Control Valve Filter/Restrictor .4-20
Pre-Operation Checklist 3-16

R

Relays 1-8

S

SAE/ISO Controls
SAE/ISO Selector Valve 3-11
Safety 2-1
Safety Decal Locations 2-16
Serial Number Location 1-1
Engine Serial Number Location 1-2
Sound Levels 1-8
Specifications 1-4
Dimensions 1-9
Dozer Blade 1-6
Electrical System 1-6
Engine 1-5
Fluid Capacities/Lubricants 1-4
Fuse Box 1-7
General Specifications 1-9
Hydraulic System 1-5
Main Fuse Box 1-7
Relays 1-8
Torque Specifications 7-2
Undercarriage and Swing System 1-6
Vibration 1-8
Storage 4-27

T

Tool Kit 3-15
Torque Specifications 7-2
Traveling on Slopes 3-19
Trench Excavating 3-26
Troubleshooting 5-1
Bucket/Boom/Dozer Blade 5-4
Engine 5-1
Indicator Lamps 5-3
Seals/Hoses 5-3
Traveling Gear 5-4

U

Using the Excavator 3-31

W

Windshield 3-14
Windshield Washer Fluid 4-27

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TORQUE SPECIFICATIONS

*Note: Use these torque values when tightening **Gehl** hardware (excluding: locknuts and self-tapping, thread forming and sheet metal screws) unless specified otherwise.*

Hydraulic fittings with various seals (light application). All torque values are in lb.-ft. (Nm) unless marked otherwise.

Thread	Straight pipe fitting with thread and screwed plug (GE)			Non-return with elastic seal	Identification aid outside Ø
	Sealing washer	Elastic seal	O-ring		
M10X1.0	7 (9)	13 (18)	11 (15)	13 (18)	0.4 in. (10 mm)
M12X1.5	15 (20)	18 (25)	18 (25)	18 (25)	0.5 in. (12 mm)
M14X1.5	26 (35)	33 (45)	26 (35)	26 (35)	0.6 in. (14 mm)
M16X1.5	33 (45)	41 (55)	30 (40)	37 (50)	0.6 in. (16 mm)
M18X1.5	41 (55)	52 (70)	33 (45)	52 (70)	0.7 in. (18 mm)
M22X1.5	48 (65)	92 (125)	44 (60)	92 (125)	0.9 in. (22 mm)
M27X2.0	66 (90)	133 (180)	74 (100)	107 (145)	1.0 in. (27 mm)
M33X2.0	111 (150)	229 (310)	118 (160)	155 (210)	1.3 in. (33 mm)
M42X2.0	177 (240)	332 (450)	155 (210)	266 (360)	1.7 in. (42 mm)
M48X2.0	214 (290)	398 (540)	192 (260)	398 (540)	1.9 in. (48 mm)
G1/8A	7 (9)	13 (18)	11 (15)	13 (18)	0.4 in. (9.73 mm)
G1/4A	26 (35)	26 (35)	22 (30)	26 (35)	0.5 in. (13.16 mm)
G3/8A	33 (45)	52 (70)	33 (45)	37 (50)	0.7 in. (16.66 mm)
G1/2A	48 (65)	66 (90)	41 (55)	48 (65)	0.8 in. (20.96 mm)
G3/4A	66 (90)	133 (180)	74 (100)	103 (140)	1.0 in. (26.44 mm)
G1A	111 (150)	229 (310)	118 (160)	140 (190)	1.3 in. (33.25 mm)
G1 1/4A	177 (240)	332 (450)	155 (210)	266 (360)	1.7 in. (41.91 mm)
G1 1/2A	214 (290)	398 (540)	192 (260)	398 (540)	1.9 in. (47.80 mm)

Hydraulic fittings with various seals (heavy application). All torque values are in lb.-ft. (Nm) unless marked otherwise.

Thread	Straight pipe fitting with thread and screwed plug (GE)			Non-return with elastic seal	Identification aid outside Ø
	Sealing washer	Elastic seal	O-ring		
M12X1.5	15 (20)	26 (35)	26 (35)	26 (35)	0.5 in. (12 mm)
M14X1.5	26 (35)	41 (55)	33 (45)	33 (45)	0.6 in. (14 mm)
M16X1.5	33 (45)	52 (70)	41 (55)	41 (55)	0.6 in. (16 mm)
M18X1.5	41 (55)	66 (90)	52 (70)	52 (70)	0.7 in. (18 mm)
M20X1.5	41 (55)	92 (125)	59 (80)	74 (100)	0.8 in. (20 mm)
M22X1.5	48 (65)	100 (135)	74 (100)	92 (125)	0.9 in. (22 mm)
M27X2.0	66 (90)	133 (180)	125 (170)	100 (135)	1.0 in. (27 mm)
M33X2.0	111 (150)	229 (310)	229 (310)	155 (210)	1.3 in. (33 mm)
M42X2.0	177 (240)	332 (450)	243 (330)	266 (360)	1.7 in. (42 mm)
M48X2.0	214 (290)	398 (540)	310 (420)	398 (540)	1.9 in. (48 mm)
G1/8A	26 (35)	41 (55)	33 (45)	33 (45)	0.5 in. (13.16 mm)
G1/4A	33 (45)	59 (80)	44 (60)	44 (60)	0.7 in. (16.66 mm)
G3/8A	48 (65)	85 (115)	55 (75)	74 (100)	0.8 in. (20.96 mm)
G1/2A	66 (90)	133 (180)	125 (170)	107 (145)	1.0 in. (26.44 mm)
G3/4A	111 (150)	229 (310)	229 (310)	192 (260)	1.3 in. (33.25 mm)
G1A	177 (240)	332 (450)	243 (330)	266 (360)	1.7 in. (41.91 mm)
G1 1/4A	214 (290)	398 (540)	310 (420)	398 (540)	1.9 in. (47.80 mm)

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With coarse-pitch thread. All torque values are in lb.-ft. (Nm) unless marked otherwise.					
Thread	Threads according to DIN 912, DIN 931, DIN 933, etc.			Threads according to DIN 7984	
	8.8	10.9	12.9	8.8	10.9
M5	4.1 (5.5)	6 (8)	7 (10)	4 (5)	5 (7)
M6	7 (10)	10 (14)	13 (17)	6.3 (8.5)	9 (12)
M8	18 (25)	26 (35)	31 (42)	15 (20)	22 (30)
M10	33 (45)	48 (65)	59 (80)	30 (40)	44 (59)
M12	64 (87)	81 (110)	108 (147)	51 (69)	74 (100)
M14	100 (135)	133 (180)	170 (230)	81 (110)	118 (160)
M16	155 (210)	203 (275)	258 (350)	125 (170)	184 (250)
M18	207 (280)	302 (410)	354 (480)	181 (245)	254 (345)
M20	302 (410)	420 (570)	509 (690)	251 (340)	361 (490)
M22	406 (550)	575 (780)	686 (930)	339 (460)	487 (660)
M24	524 (710)	738 (1000)	878 (1190)	435 (590)	620 (840)
M27	767 (1040)	1092 (1480)	1305 (1770)	642 (870)	922 (1250)
M30	1047 (1420)	1482 (2010)	1770 (2400)	885 (1200)	1254 (1700)

With fine-pitch thread. All torque values are in lb.-ft. (Nm) unless marked otherwise.					
Thread	Threads according to DIN 912, DIN 931, DIN 933, etc.			Threads according to DIN 7984	
	8.8	10.9	12.9	8.8	10.9
M8X1.0	18 (25)	27 (37)	32 (43)	16 (22)	24 (32)
M10X1.0	37 (50)	55 (75)	65 (88)	32 (43)	48 (65)
M10X1.25	36 (49)	52 (71)	61 (83)	31 (42)	46 (62)
M12X1.25	64 (87)	96 (130)	111 (150)	55 (75)	81 (110)
M12X1.5	61 (83)	92 (125)	107 (145)	53 (72)	77 (105)
M14X1.5	100 (135)	148 (200)	173 (235)	89 (120)	129 (175)
M16X1.5	155 (210)	229 (310)	266 (360)	133 (180)	195 (265)
M18X1.5	232 (315)	332 (450)	391 (530)	199 (270)	284 (385)
M20X1.5	325 (440)	465 (630)	538 (730)	277 (375)	391 (530)
M22X1.5	435 (590)	620 (840)	723 (980)	369 (500)	524 (710)
M24X2.0	546 (740)	789 (1070)	922 (1250)	465 (630)	664 (900)
M27X2.0	811 (1100)	1143 (1550)	1328 (1800)	679 (920)	959 (1300)
M30X2.0	1106 (1500)	1586 (2150)	1844 (2500)	959 (1300)	1364 (1850)

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WARNING

THIS OPERATOR'S MANUAL IS PROVIDED FOR OPERATOR USE

DO NOT REMOVE FROM THIS MACHINE

Do not start, operate or work on the machine until you carefully read and thoroughly understand the contents of this Operator's Manual.

Failure to follow safety, operating and maintenance instructions can result in serious injury to the operator or bystanders, poor operation, and costly breakdowns.

If you have any questions on proper operation, adjustment or maintenance of the machine, contact your dealer or the Gehl Company Service Department before starting or continuing operation.

California Proposition 65 Warnings:

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer and birth defects and other reproductive harm.

Battery post, terminals and related accessories contain lead and lead compounds, chemicals known to the State of California to cause cancer and birth defects and other reproductive harm. **Wash hands after handling battery**.

GEHL®

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